Adaptácia lesných ekosystémov na globálne environmentálne zmeny

vplyv obhospodarovania lesa na štruktúru lesa a environmentálne aspekty lesných ekosystémov (prostredie, mikroklíma, pôdy, biodiverzita a pod.)

potenciál lesných ekosystémov pri zmierňovaní dopadov GEZ,

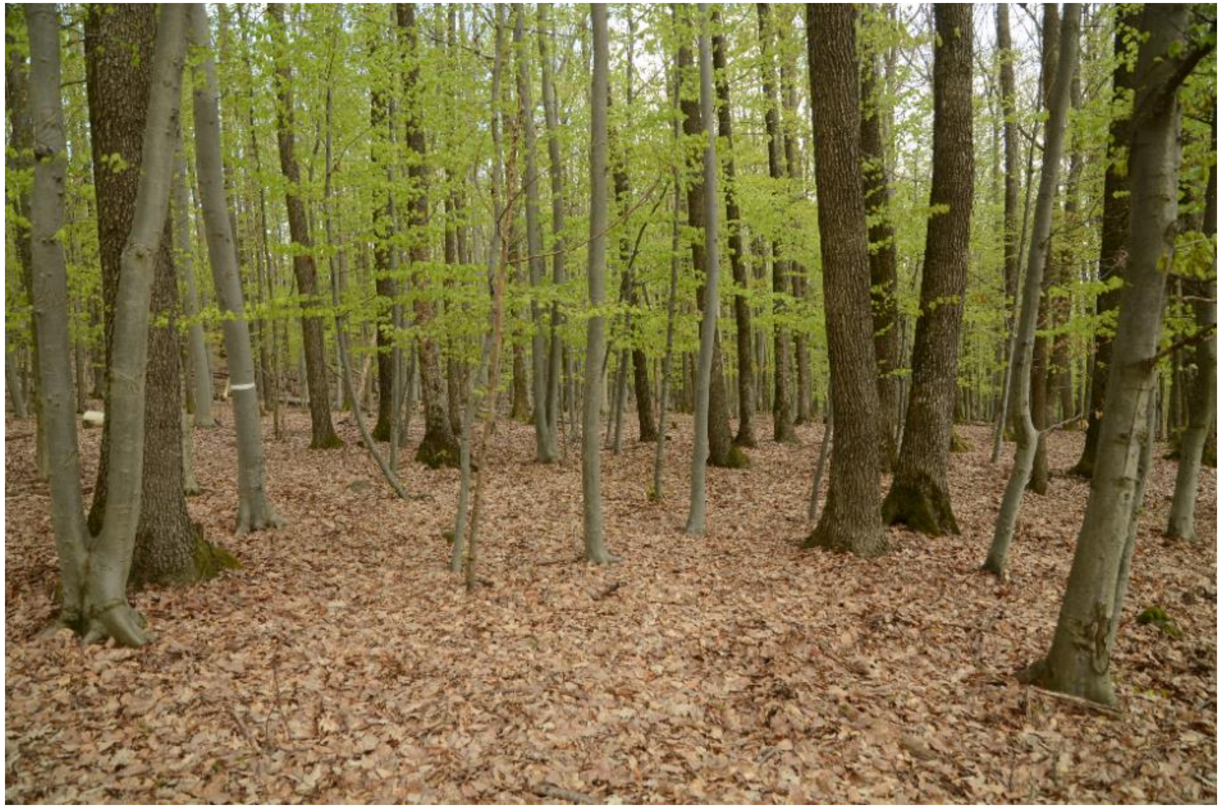
sekvestrácia uhlíka, lesná mikroklíma, alternatívne formy manažmentu

Vplyv obhospodarovania lesa na štruktúru lesa a environmentálne aspekty lesných ekosystémov

Zmena vo využívaní dubových lesov

Výmladkovo obhospodarované lesy nízkeho tvaru s krátkou rubnou dobou boli prevádzané na lesy vysoké

Mezofilizácia, eutrofizácia a taxonomická homogenizácia



- menej svetla (slnečného žiarenia)
- vlhkejšia chladnejšia mikroklíma
- viac listového opadu a z iných drevín – zmena vlastností hornej vrstvy pôd

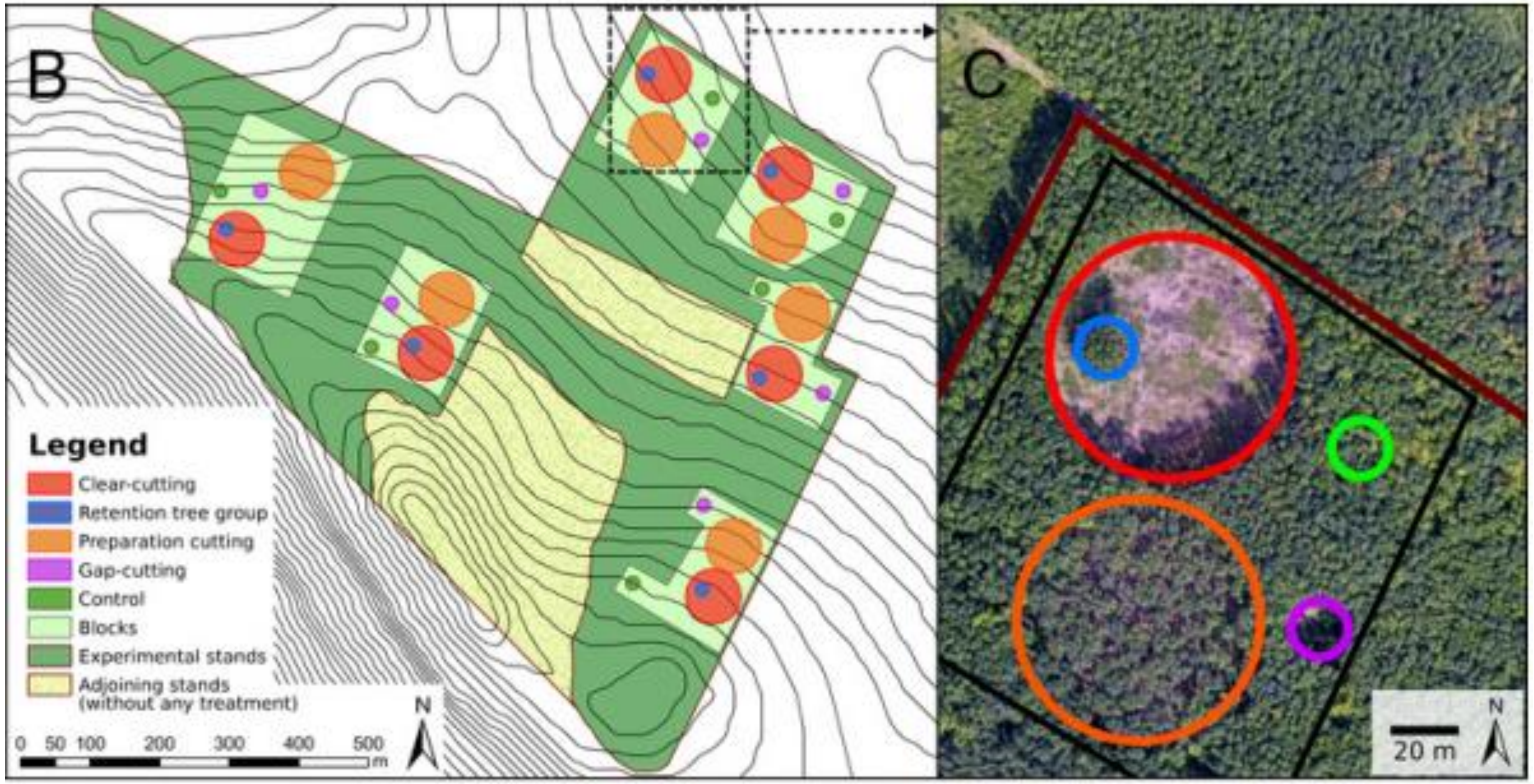
Ako by sme teda mali obhospodarovať dubové lesy?

Ako obhospodarovať dubové lesy?

Intenzívnejšie. Historické formy sú ale pre súčasnosť nevhodné.

Alternatívne formy obhospodarovania dubových lesov (experimenty)

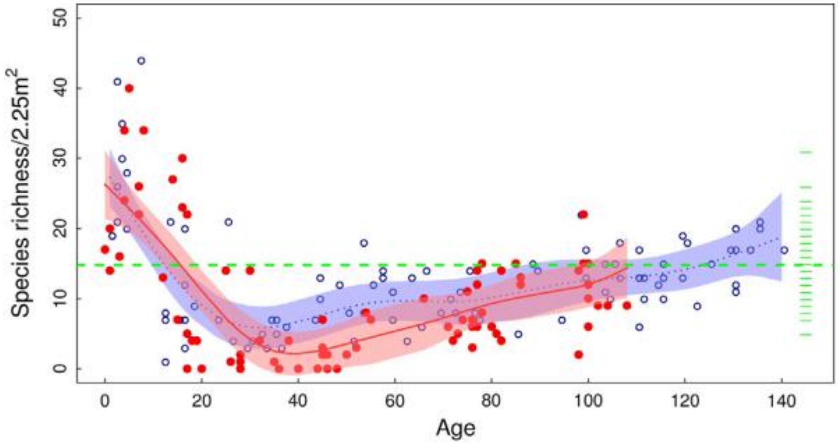
O tom viac nabudúce

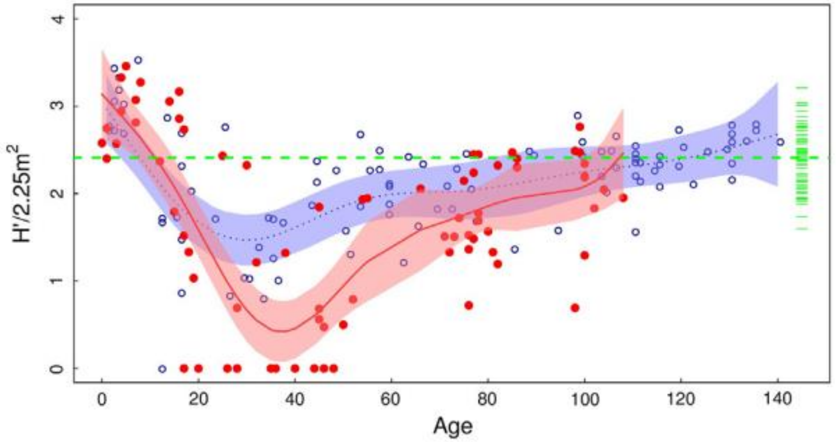


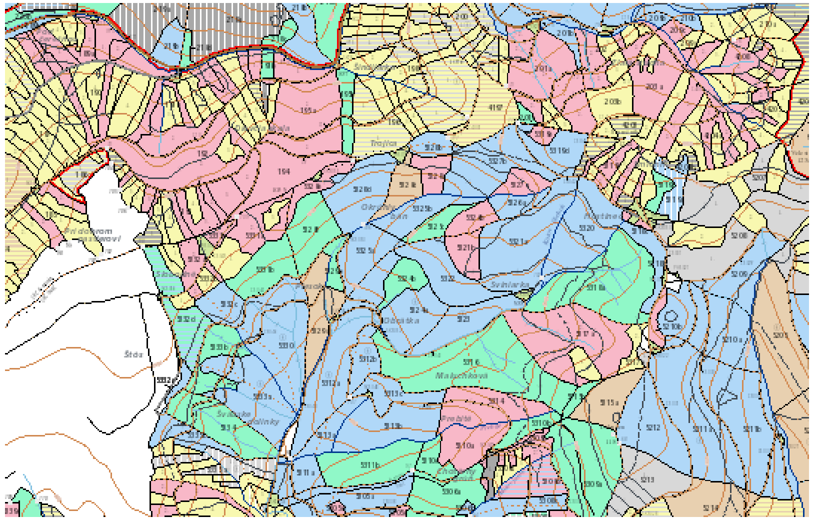
Tinya et al. (2019). Initial understory response to experimental silvicultural treatments in a temperate oak-dominated forest. European Journal of Forest Research, 138(1), 65-77.

Horské lesy – opačná situácia

Historicky málo využívané, transformované na lesy vekových tried
Mladé a husté porasty druhovo chudobné
100 rokov obnova druhovej diverzity vegetácie

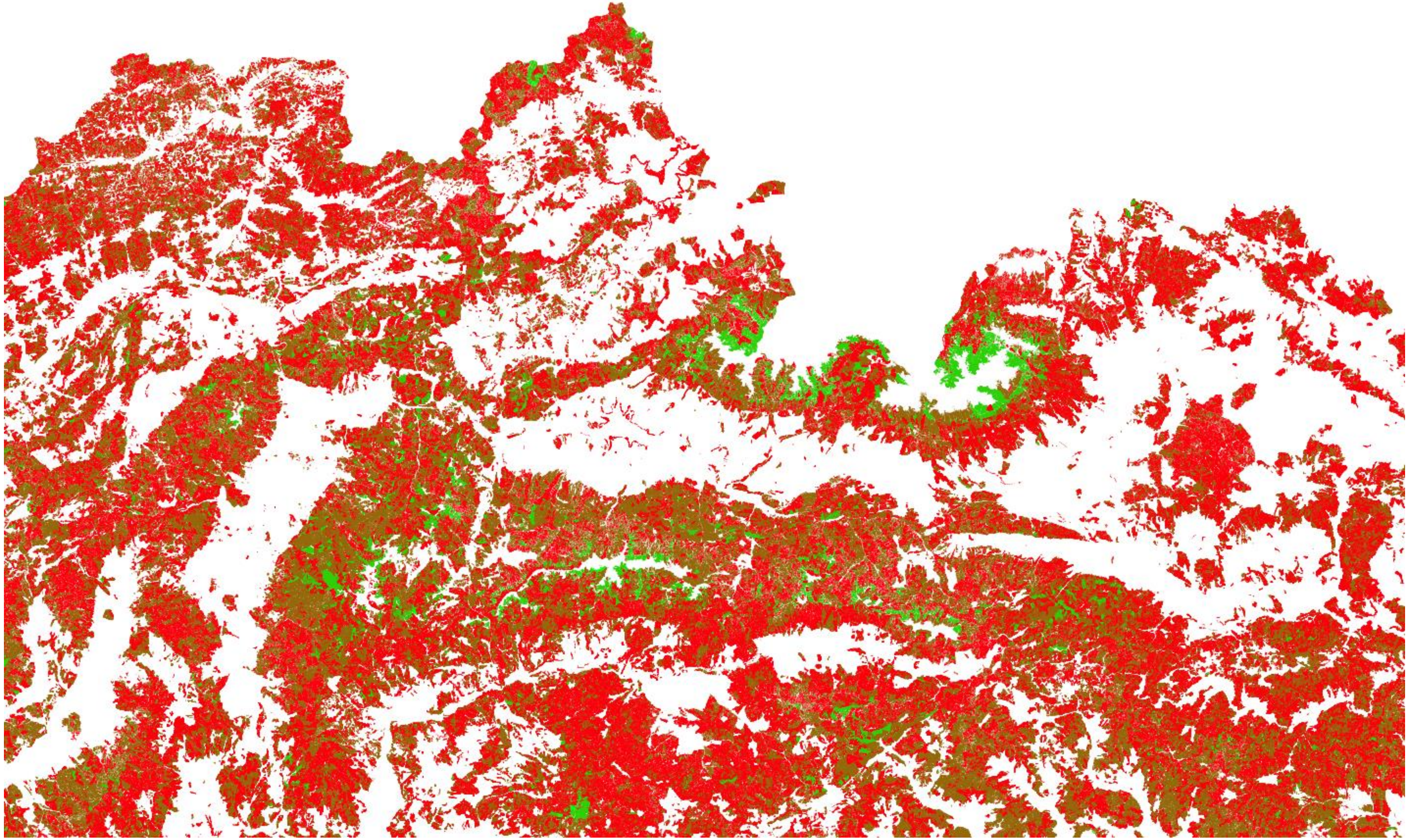






Veľké plochy mladých lesov

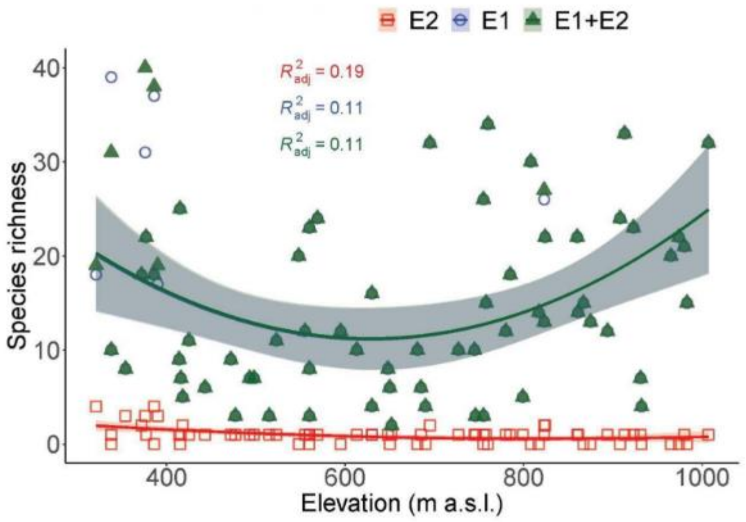
Problémom pre biodiverzitu je veľké zastúpenie a veľkoplošnosť mladých (hustých) porastov



Červená 0–70 rokov
Hnedá 70–140 rokov
Zelená >140 rokov

Horské lesy vekových tried – diverzita vs. štruktúra

V hustých homogénnych bukových lesoch (nielen mladých, aj starších) s veľkou biomasou jemných koreňov je veľmi nízka druhová diverzita rastlín



Science of The Total Environment
Volume 849, 25 November 2022, 157825

Competition for soil resources forces a trade-off between enhancing tree productivity and understorey species richness in managed beech forests

Richard Hrivnák [a], Michal Bošeľa [b], Michal Slezák [c], Martin Lukac [d, e], Ivana Svitková [a], Jaroslav Gizela [f], Katarína Hegedüšová [a], Matúš Hrivnák [b], Ján Kliment [g], Vlastimil Knopp [b], Dušan Senko [a], Mariana Ujházyová [b], Milan Valachovič [a], Maroš Wiezik [b, 1], František Máliš [b, f]

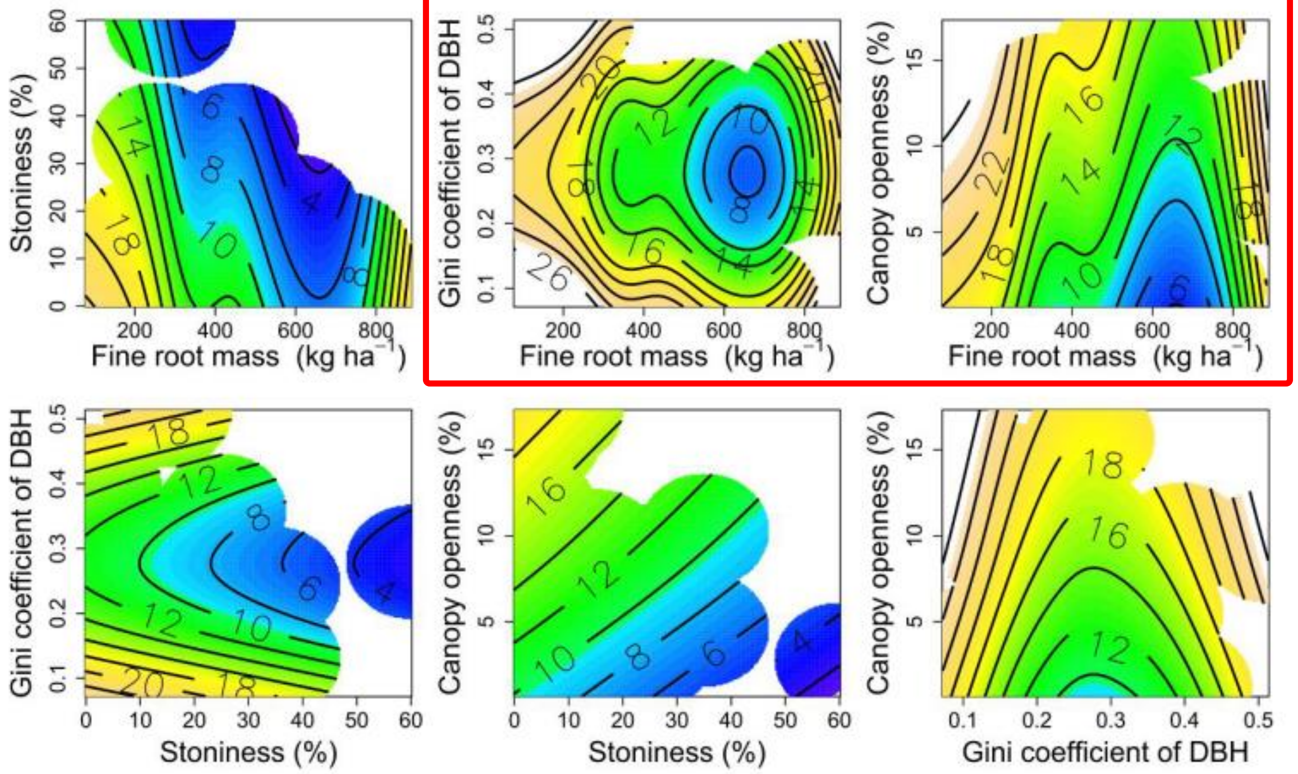
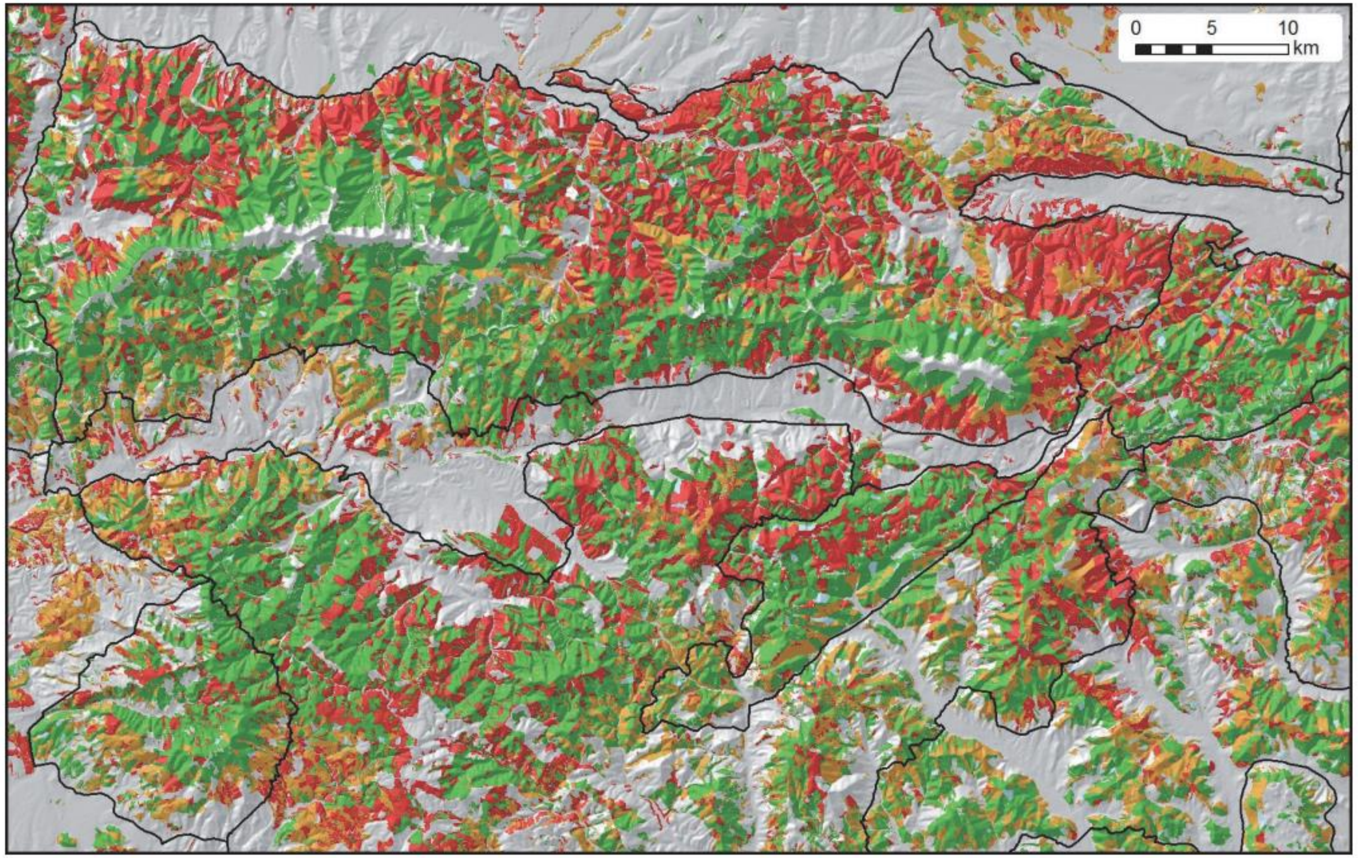


Figure 4 Contour maps of interactive effects of pairs of driving variables on understorey species richness. Data were generated by the final GAM model where all other variables were held at mean value. Numbers and colours indicate understorey species richness.

Zmena drevinového zloženia horských lesov

Najmä zmeny v prospech smreka v horských lesoch



Obrázok 3.3.4. Príklad klasifikácie prirodzenosti lesa v oblasti Nízkych Tatier, Poľany a Slovenského rudohoria s využitím navrhnutej poznatkovej bázy (zelená – prirodzené, ekologicky vhodné; žltá – poloprirodzené, ekologicky prípustné; červená – neprirodzené, ekologicky nevhodné SPT, čierna línia – hranice lesných oblastí)

Tabuľka 22 Zastúpenie drevín 5. vs

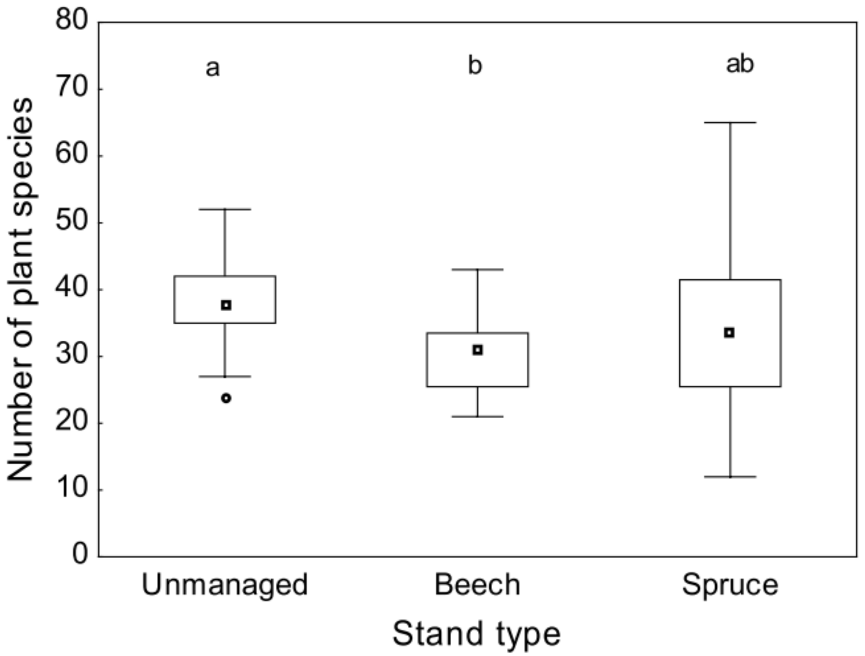
Dreviny	Súčasné %	Pôvodné %
Ihličnaté dreviny ▼		
Picea abies	52,86	3,00
Abies alba	10,04	43,18
Pinus sylvestris	3,44	0,34
Larix decidua	2,66	0,24
Pseudotsuga menziesii	0,04	
Pinus nigra	0,02	
Sorbus aucuparia	0,01	
Taxus baccata		0,20
Ihličnany spolu	**69,08**	**46,96**
Listnaté dreviny ▼		
Fagus sylvatica	25,33	46,79
Acer pseudoplatanus	2,90	3,29
Fraxinus excelsior	1,01	0,19
Betula sp.	0,89	0,05
Alnus incana	0,25	0,03
Sorbus aucuparia	0,18	0,14
Alnus glutinosa	0,11	0,09
Populus tremula	0,07	0,02
Ulmus glabra	0,06	1,07
Tilia sp.	0,05	0,06
Carpinus betulus	0,03	
Acer platanoides	0,02	0,95
Salix caprea	0,02	0,02
Quercus sp.	0,01	
Sorbus aria		0,35
Listnáče spolu	**30,92**	**53,04**

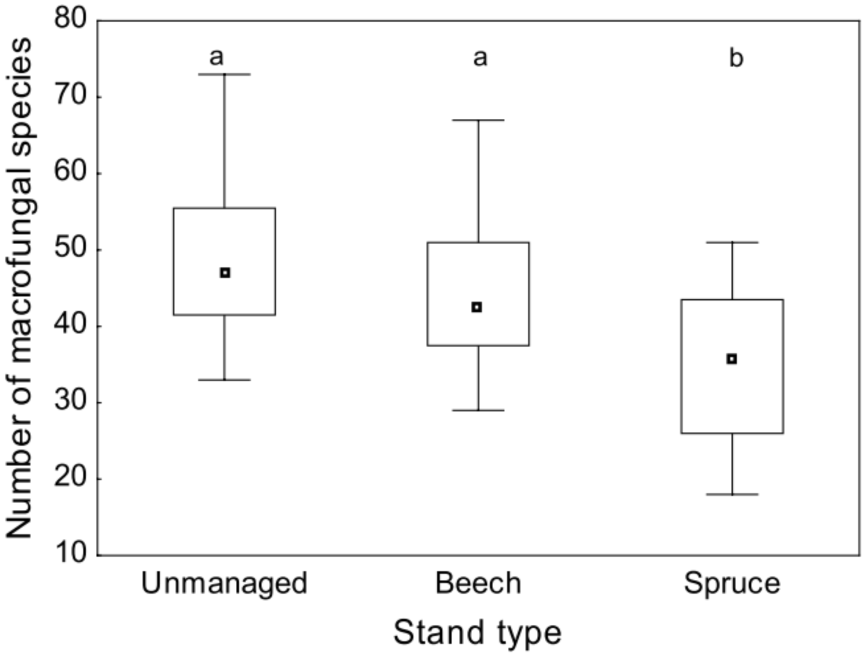
Vladovič et al. 2014: Reakcia diverzity lesných fytocenóz na zmenu edaficko-klimatických podmienok Slovenska. TU Zvolen
Vladovič et al. 2011: Štruktúra a diverzita lesných ekosystémov na Slovensku, Národné lesnícke cetnrum

Horské lesy - les vekových tried - huby

jedľové bučiny vs hosp. bučiny a smrečiny

v priemere sú rozdiely pri cievnatých rastlinách malé, avšak húb (makromycéty – „klasické“ veľké huby s plodnicami) je v hosp. lesoch, hlavne v smrečinách podstatne menej



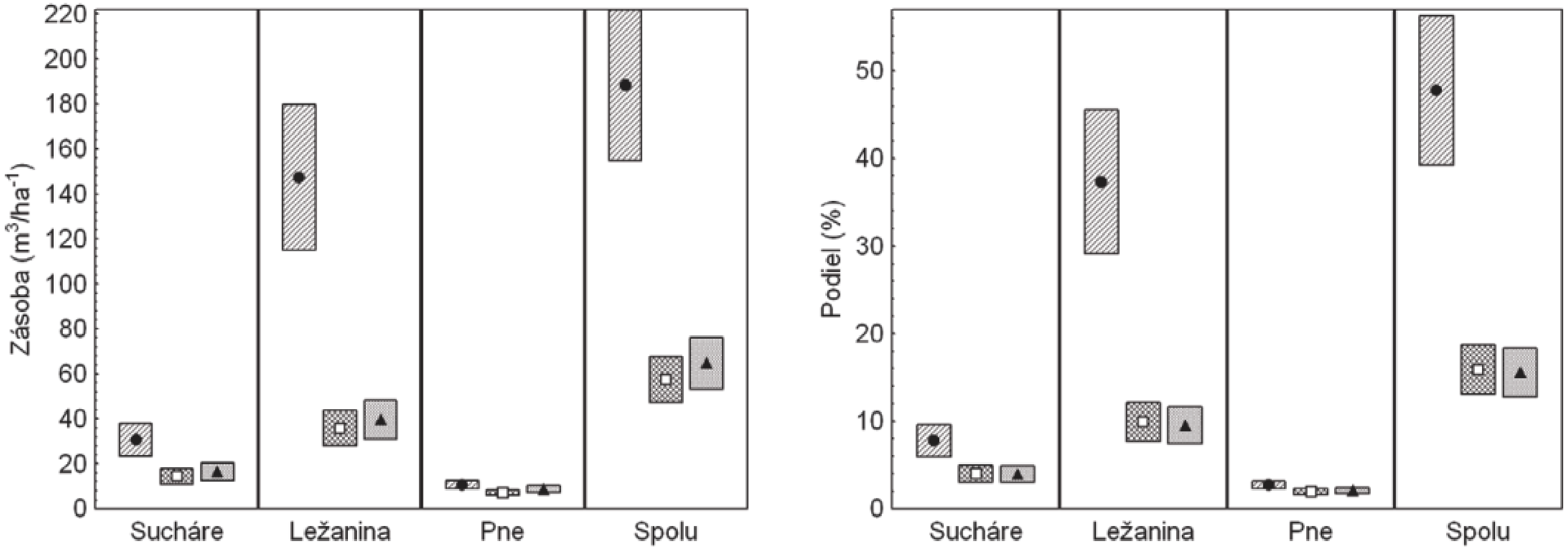


Ujházy et al. (2018). Response of fungal and plant communities to management-induced overstorey changes in montane forests of the Western Carpathians. European Journal of Forest Research, 137(2), 169-183.

Les vekových tried - mŕtve drevo

Špecifický životný priestor pre mnohé organizmy, napr. huby, dutinové hniezdiče
Veľký význam pri regenerácii horských smrekových lesov

V obhospodarovaných lesoch je podstatne menej mŕtveho dreva, ako je prirodzené – negatívny vplyv na mnohé organizmy



a) b)

Obrázok 4.2.1. Priemerná hektárová zásoba odumretého dreva (a) a pomer odumretého dreva voči zásobe živých stromov (b) podľa stupňov prirodzenosti pre spoločenstvá 5. jedľovo-bukového vs
Legenda: Priemerná hodnota ● pre stupeň prirodzenosti 1, ◻ pre stupeň prirodzenosti 2, ▲ pre agregovaný stupeň prirodzenosti 3, 4 a 5, ▨ ▩ ▒ 95 % interval spoľahlivosti priemernej hodnoty

Vladovič et al. 2011: Štruktúra a diverzita lesných ekosystémov na Slovensku, Národné lesnícke cetnrum

Mŕtve drevo

Na Slovensku máme nadpriemerné množstvo mŕtveho dreva v rámci EÚ

Avšak hlavne sucháre

Annals of Forest Science (2019) 76: 68
https://doi.org/10.1007/s13595-019-0832-0

DATA PAPER

Check for updates

A dataset of forest volume deadwood estimates for Europe

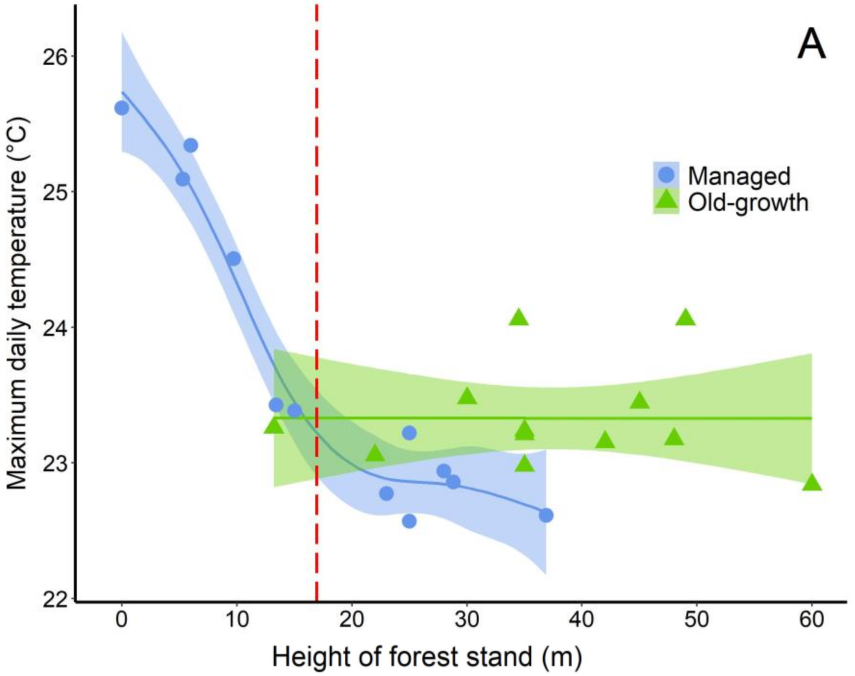
Nicola Puletti[1] · Roberto Canullo[2,3] · Walter Mattioli[1] · Radosław Gawryś[4] · Piermaria Corona[1] · Janusz Czerepko[4]

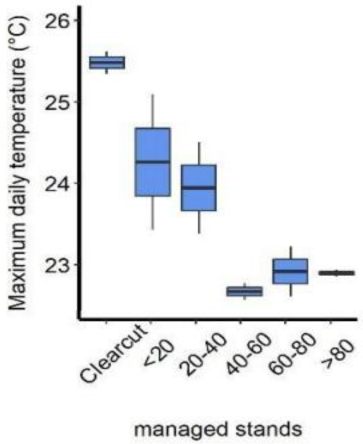
Deadwood type	Description of deadwood type
SDT: standing dead trees	A standing dead tree recorded if DBH ≥ 10 cm and H_{tot} ≥ 1.3 m
LDT: lying dead trees	Lying dead trees was recorded if DBH ≥ 10 cm
snag	Snag recorded if l_{tot} ≥ 1.3 m and d_{half} ≥ 10 cm
CWD: coarse woody debris	*CWD* recorded if d_{half} > 10 cm
stump	Stump recorded if h_{cut} < 1.3 m and d_{cut} ≥ 10 cm

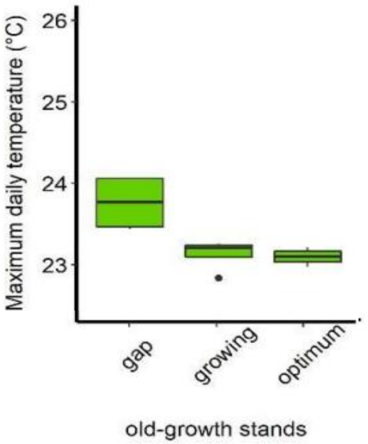
Table 2 Mean values of deadwood volume (m^3 ha^{-1}) and their 95% confidence interval estimates distinguished by Country and deadwood type (see the text for acronyms)

Country	SDT	LDT	Snag	CWD	Stump	Number of plots	Mean volume
Austria	$9.1^{\pm 2.9}$	0.0	0.0	$14.6^{\pm 3.3}$	0.0	136	$23.7^{\pm 4.6}$
Belgium	$4.8^{\pm 2.4}$	$6.0^{\pm 4.8}$	$1.3^{\pm 1.3}$	$3.6^{\pm 2.3}$	$1.0^{\pm 0.2}$	10	$17.5^{\pm 8.1}$
Cyprus	$0.2^{\pm 0.2}$	$1.0^{\pm 0.6}$	$24.9^{\pm 24.9}$	$0.2^{\pm 0.2}$	$0.5^{\pm 0.3}$	19	$26.9^{\pm 24.8}$
Czech Rep.	0.0	0.0	0.0	$3.8^{\pm 0.7}$	$5.7^{\pm 0.5}$	146	$9.8^{\pm 1.0}$
Denmark	$1.4^{\pm 0.9}$	0.0	0.0	$4.8^{\pm 3.2}$	0.0	22	$6.2^{\pm 3.2}$
Finland	$1.6^{\pm 0.3}$	$0.6^{\pm 0.2}$	$0.4^{\pm 0.1}$	$2.1^{\pm 0.2}$	$2.4^{\pm 0.1}$	630	$7.1^{\pm 0.5}$
France	$7.9^{\pm 1.9}$	0.0	$2.0^{\pm 0.4}$	$9.7^{\pm 1.0}$	$2.2^{\pm 0.1}$	548	$22.3^{\pm 2.4}$
Germany	$3.3^{\pm 0.8}$	$1.3^{\pm 0.4}$	$7.0^{\pm 2.5}$	$11.9^{\pm 1.1}$	$5.8^{\pm 0.5}$	226	$29.6^{\pm 3.0}$
Hungary	$3.6^{\pm 1.5}$	$0.1^{\pm 0.1}$	$1.1^{\pm 0.4}$	$3.9^{\pm 1.0}$	$0.7^{\pm 0.2}$	78	$9.7^{\pm 1.9}$
Ireland	0.0	0.0	0.0	$1.4^{\pm 0.4}$	$4.5^{\pm 1.1}$	35	$6.1^{\pm 1.4}$
Italy	$5.8^{\pm 1.3}$	$1.3^{\pm 0.5}$	$2.7^{\pm 1.6}$	$2.7^{\pm 0.5}$	$2.0^{\pm 0.3}$	224	$14.9^{\pm 2.4}$
Latvia	$7.1^{\pm 1.3}$	$3.8^{\pm 1.6}$	$3.0^{\pm 0.8}$	$10.7^{\pm 1.6}$	$1.2^{\pm 0.2}$	95	$26.4^{\pm 3.2}$
Lithuania	$5.8^{\pm 2.0}$	$5.4^{\pm 3.2}$	$1.5^{\pm 0.4}$	$3.0^{\pm 0.7}$	$2.0^{\pm 0.3}$	62	$17.7^{\pm 3.9}$
Poland	$2.4^{\pm 1.1}$	$0.1^{\pm 0.0}$	$0.8^{\pm 0.3}$	$3.9^{\pm 0.8}$	$2.6^{\pm 0.2}$	438	$9.9^{\pm 1.8}$
Slovak Rep.	$9.7^{\pm 2.1}$	0.0	0.0	$12.1^{\pm 1.8}$	$4.8^{\pm 0.5}$	108	$27.3^{\pm 3.5}$
Slovenia	$18.3^{\pm 7.6}$	$5.0^{\pm 2.0}$	$0.9^{\pm 0.4}$	$5.2^{\pm 1.5}$	$3.2^{\pm 0.5}$	44	$33.1^{\pm 7.8}$
Spain	$1.8^{\pm 0.5}$	$0.1^{\pm 0.1}$	$0.5^{\pm 0.2}$	$2.1^{\pm 0.5}$	$1.0^{\pm 0.2}$	155	$5.6^{\pm 0.9}$
Sweden	$2.4^{\pm 1.2}$	$2.3^{\pm 1.1}$	$3.2^{\pm 0.8}$	$15.3^{\pm 3.5}$	$1.1^{\pm 0.1}$	100	$24.4^{\pm 5.2}$
United Kingdom	0.0	0.0	$4.7^{\pm 2.7}$	$9.3^{\pm 1.9}$	$1.3^{\pm 0.2}$	167	$15.5^{\pm 4.2}$
EU19	*$4.1^{\pm 0.4}$*	*$0.7^{\pm 0.1}$*	*$1.8^{\pm 0.3}$*	*$6.4^{\pm 0.3}$*	*$2.5^{\pm 0.1}$*	*3243*	*$15.8^{\pm 0.7}$*

Les vekových tried a lesná mikroklíma

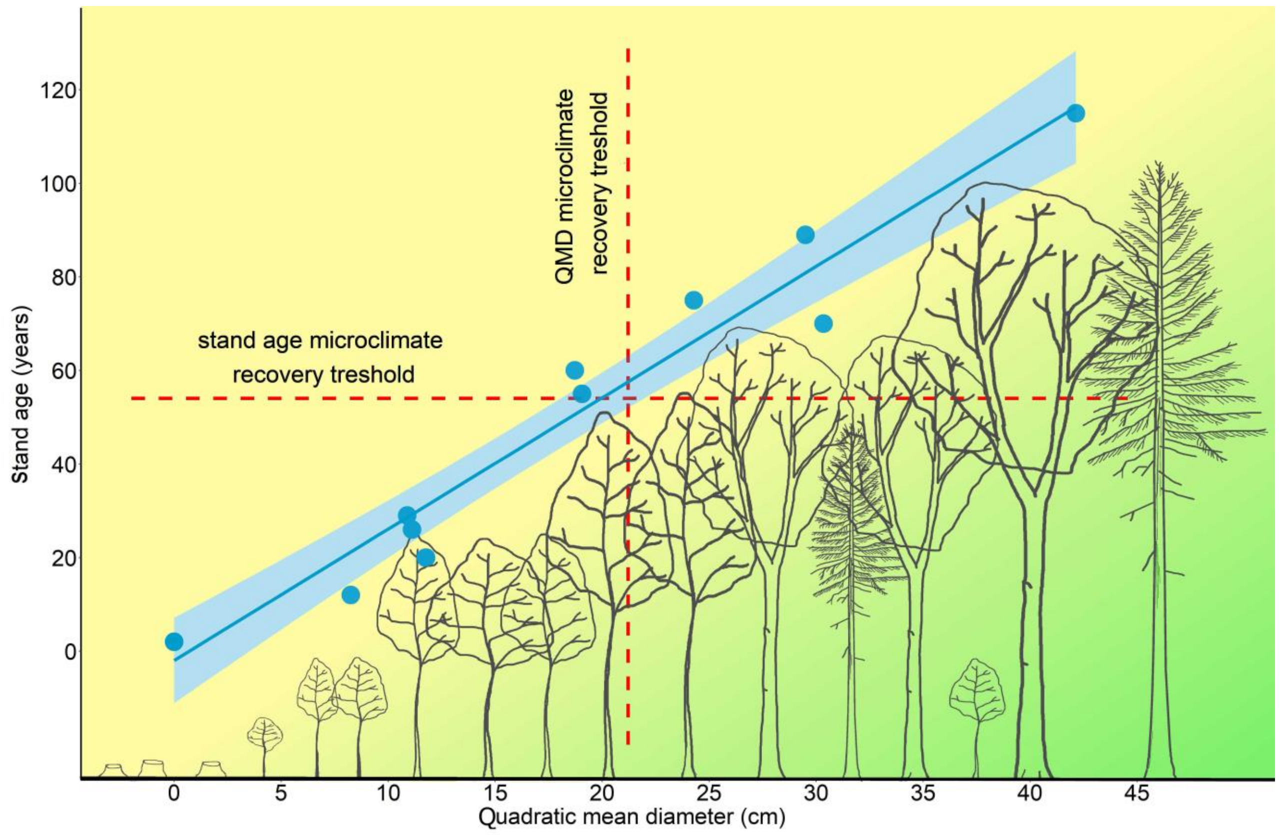






Lesná mikroklíma sa obnoví až po cca 50 rokoch, keď má porast hrúbku okolo 20 cm a výšku okolo 20 m

Jedľové bučiny na Poľane



Máliš et al. 2023 : Microclimate variation and recovery time in managed and old-growth temperate forests, Agricultural and Forest Meteorology 342, 109722

Les vekových tried a lesná mikroklíma

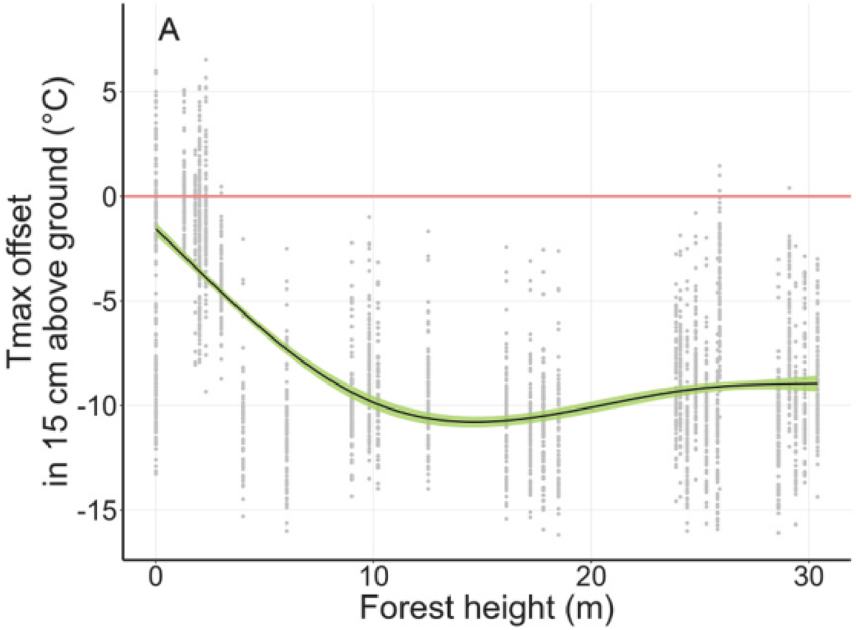
Dubové lesy na úpätí Poľany

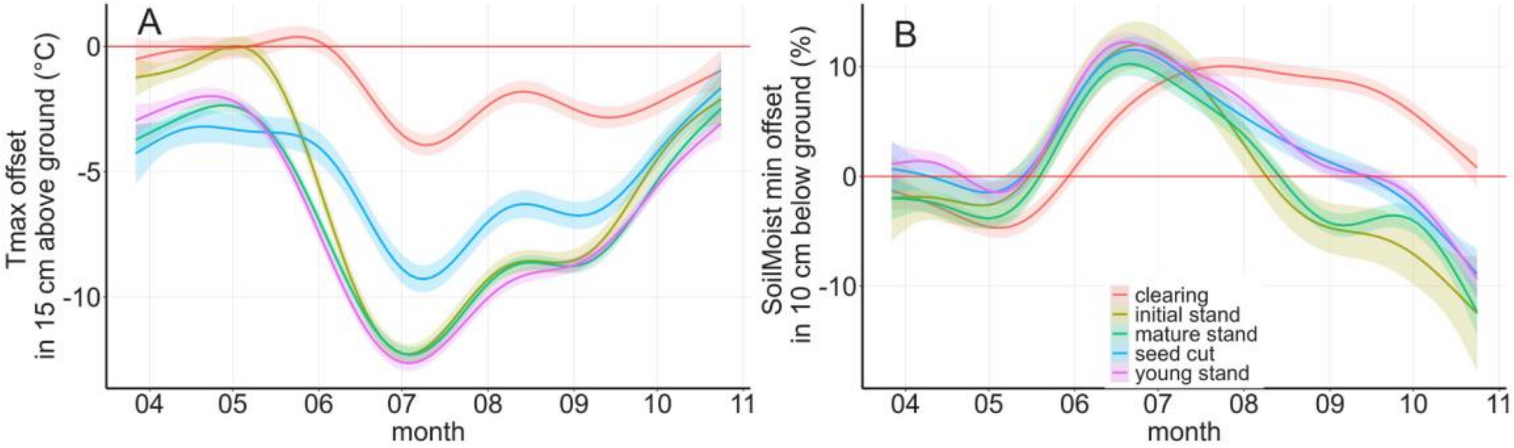
Lesná mikroklíma sa obnoví pri výške okolo 15-20 m

Sezóne zmeny – v lete tlmivý účinok najvýraznejší

Okrem nižšej teploty aj vyššia vlhkosť pôdy

Dôležitá je maximálna denná teplota (deficit vodných pár – nasýtenosť vzduchu vodnou parou)



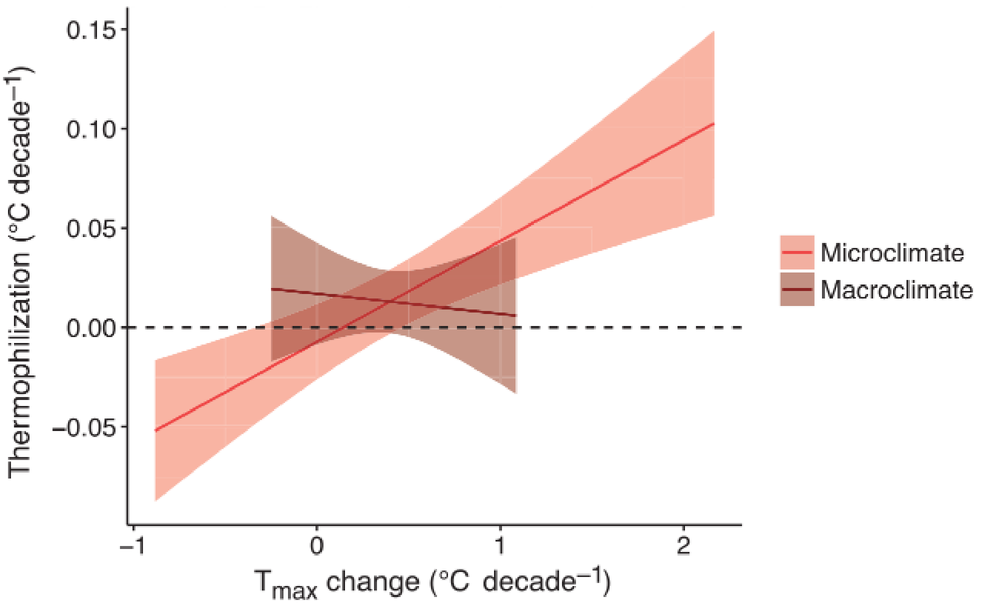


Csölleová et al. (2024). Post-harvest recovery of microclimate buffering and associated temporary xerophilization of vegetation in sub-continental oak forests. Forest Ecology and Management, 572, 122238.

Spôsobí „strata“ lesnej mikroklímy termofilizáciu vegetácie?

Termofilizácia súvisí s mikroklímou, nie makroklímou

Na rúbaniskách rastú teplomilnejšie a suchotolerantnejšie druhy. Ale je pravdepodobný návrat do pôvodného stavu



Zellweger et al. (2020). Forest microclimate dynamics drive plant responses to warming. Science, 368(6492), 772-775.

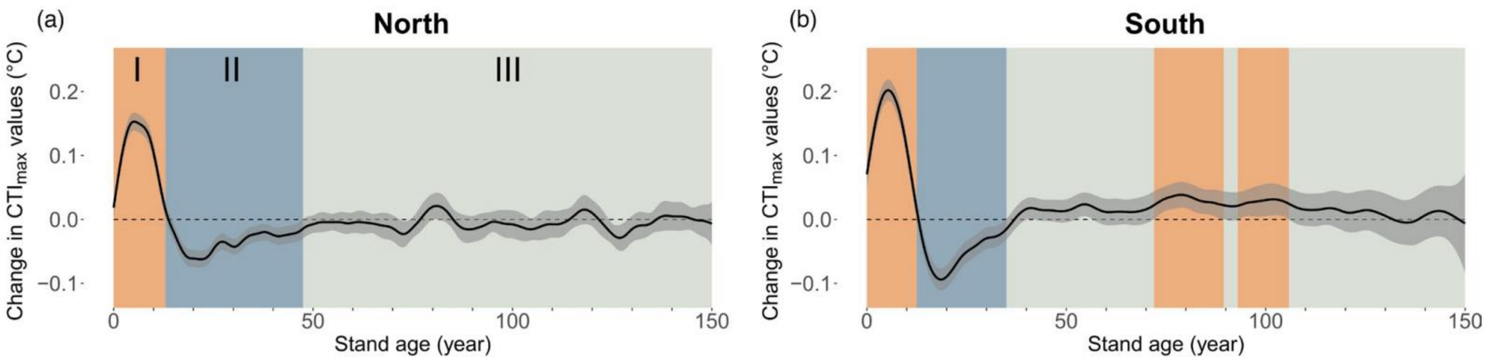


FIGURE 2 Predicted mean changes in CTI_{max} (a, b) and CTI_{min} (c, d) between inventories of 10 years with 95% confidence interval in relation to stand age. Orange and blue colours highlight periods of stand age where changes in CTI values were significantly different from zero during a period of at least 10 years. Orange denotes periods of increases in CTI values, and blue denotes periods of decreases in CTI values. Grey colour denotes periods of stand age where change in CTI values was not significantly different from zero for at least 10 years. Numbers on Figure 2a refer to highlighted phases of stand age, where first phase after clear-cutting shows general increases in CTI values, followed by second phase with general decreases, and lastly a longer and relatively stable third phase

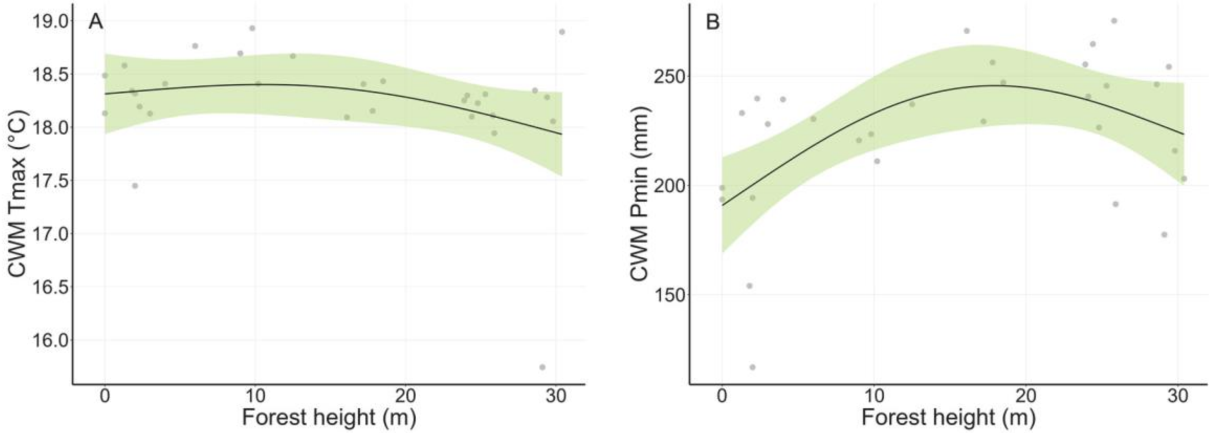
Christiansen, D. M., Iversen, L. L., Ehrlén, J., & Hylander, K. (2022). Changes in forest structure drive temperature preferences of boreal understorey plant communities. Journal of Ecology, 110(3), 631-643.

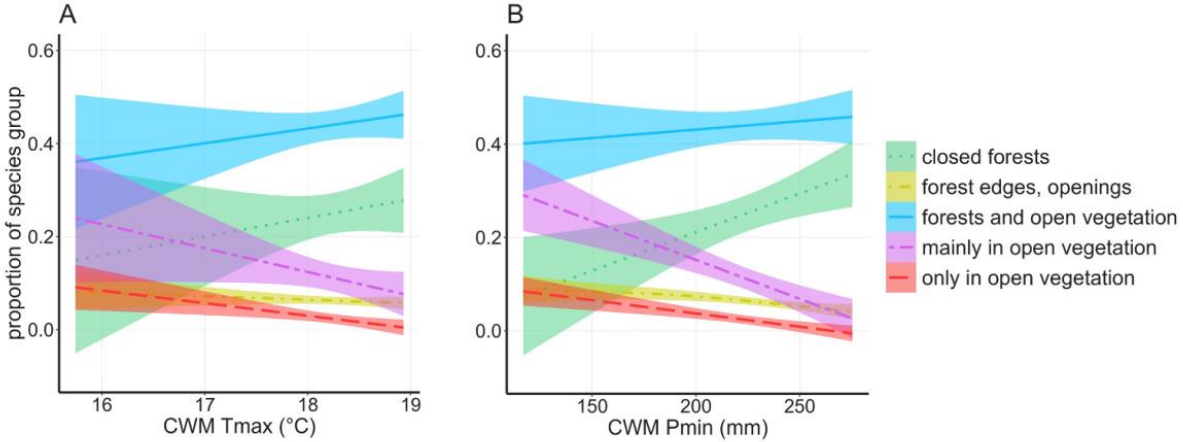
Les vekových tried a lesná mikroklíma

Dubové lesy na úpätí Poľany

Bez termofilizácie, suchotolerantnejšie druhy na rúbaniskách

Zmeny súvisia s prítomnosťou „nelesných" druhov





Csölleová et al. (2024). Post-harvest recovery of microclimate buffering and associated temporary xerophilization of vegetation in sub-continental oak forests. Forest Ecology and Management, 572, 122238.

Termofilizácia či adaptácia?

Termofilizácia vs. adaptácia na globálne otepľovanie – uhol pohľadu

Výsledky indikujú, že niektoré dreviny môžu mať problém s regeneráciou v makroklimatických podmienkach rúbaniska

Received: 5 March 2020 | Revised: 27 July 2020 | Accepted: 29 July 2020
DOI: 10.1111/geb.13177

RESEARCH PAPER

Global Ecology and Biogeography WILEY

Windstorm-induced canopy openings accelerate temperate forest adaptation to global warming

Lucie Dietz | Catherine Collet | Jean-Luc Dupouey | Eric Lacombe | Lisa Laurent | Jean-Claude Gégout

Termofilizácia po presvetlení

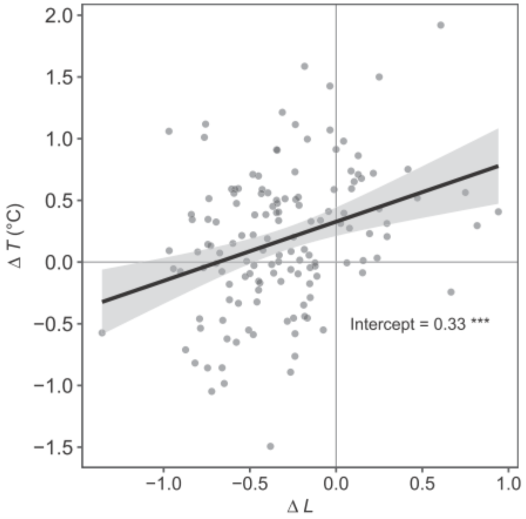


FIGURE 3 Relationship between the community temperature index change between 2002 and 2018 (Δ*T*) and the community light index change between 2002 and 2018 (Δ*L*) in the gap plots. Regression line and 95% confidence interval are displayed. The departure from 0 of Δ*T* when Δ*L* = 0 (intercept of the regression line) is indicated (****p* < .001)

Vyšší podiel teplomilných a nižší chladnomilných druhov

	Gap 2002 (G02)	Gap 2018 (G18)	Undisturbed forest (UF18)	G18–G02	G18–UF18
Warm adapted species (SW)					
Proportion	.44 (.13)	0.46 (.14)	.42 (.15)	**.017***	**.037*****
Number	10.9	11.1	9.5	0.16	**1.5*****
Cold adapted species (SC)					
Proportion	.43 (.12)	.40 (.12)	.44 (.14)	**−.027*****	**−.041******
Number	10.3	9.3	9	**−1.1*****	0.26
Intermediate species (SI)					
Proportion	.13 (.08)	.14 (.1)	.14 (.14)	.01	.0049
Number	3.3	3.4	3.9	0.11	**0.51****

Note: Differences between years and between disturbance regimes have been calculated and entered in the table. The average proportion for each species category over all plots is given followed by its standard deviation in parentheses. Significance of differences was tested with a Student's paired *t* test and represented in bold font (**p* < .1. ***p* < .05. ****p* < .01. *****p* < .0001. Non-significant otherwise).

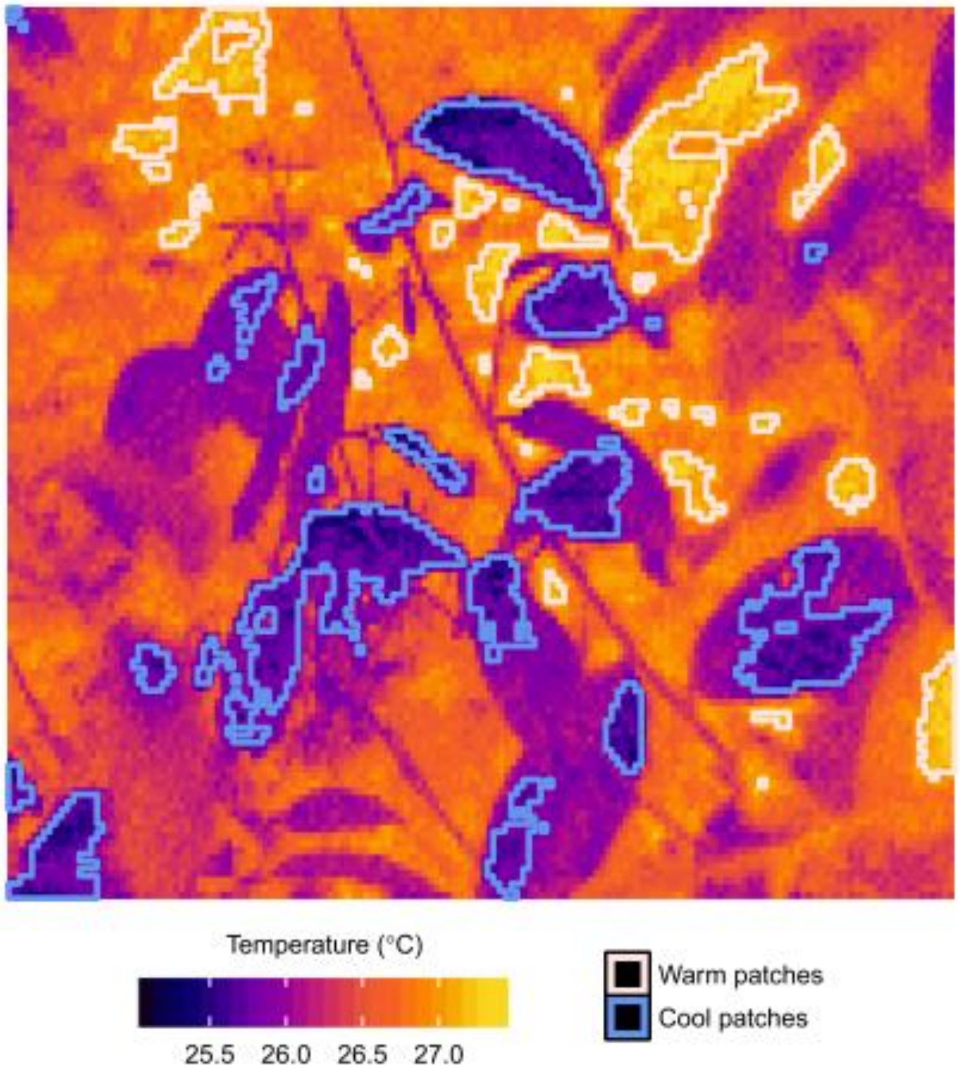
TABLE 1 Proportion and mean number of warm adapted species, cold adapted species and intermediate species in the gap plots in 2002 and 2018, and in the undisturbed forests in 2018

Formy manažmentu a mikroklíma

vytvorenie podmienok pre druhy s rôznymi nárokmi, rôznou odolnosťou

prítomnosť mikrorefúgií pre lesné, citlivé druhy

otvorenie porastu v prospech svetlomilných druhov



Senior et al. (2018). Tropical forests are thermally buffered despite intensive selective logging. Global Change Biology, 24(3), 1267-1278.

Pri mikroklíme nejde len o rastliny

Populácie lesných druhov vtákov sú podstatne ovplyvnené mikroklimatickými podmienkami a štruktúrou lesa

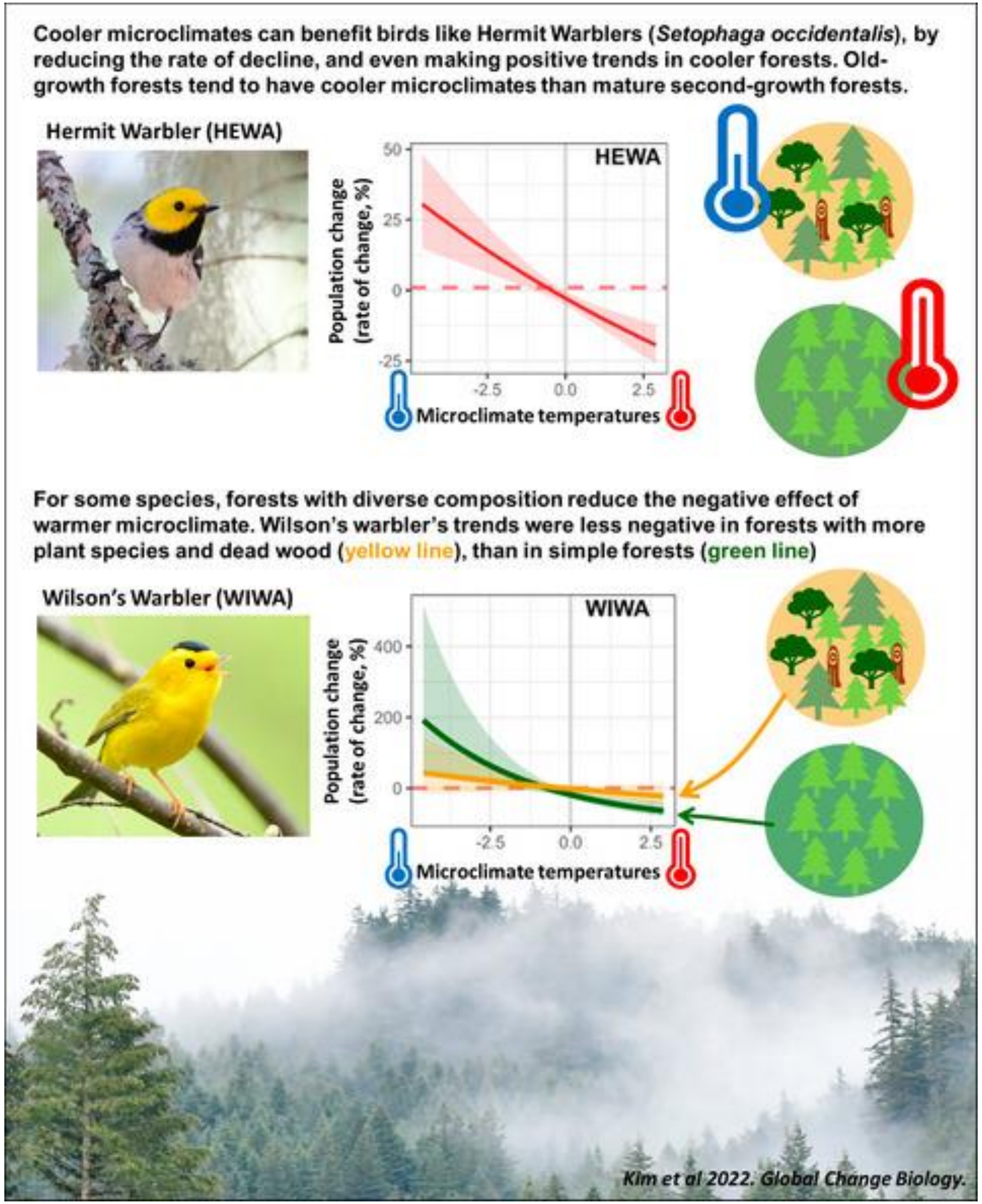
- v prírodných lesoch je „chladnejšie“ ako hospodárskych
- pri oteplení lesnej mikroklímy miernejšie dopady v prírodných lesoch
- možné pozitívne účinky mŕtveho dreva (akumulácia vody)

Received: 28 March 2022 | Revised: 14 July 2022 | Accepted: 18 July 2022
DOI: 10.1111/gcb.16353
Global Change Biology WILEY

RESEARCH ARTICLE

Forest microclimate and composition mediate long-term trends of breeding bird populations

Hankyu Kim[1,2] | Brenda C. McComb[1,3] | Sarah J. K. Frey[1,3] | David M. Bell[4] | Matthew G. Betts[1,3]



Mikroklíma a mŕtve drevo

Mŕtve drevo nemalo vplyv na mikroklímu bukových lesov

Otázka kvality (stupňa rozkladu) mŕtveho drevo

Otázka priestorovej škály – mikroklíma vnútra porastu nie, ale samotné mŕtve drevo je osobitým substrátom s rôznymi, aj mikroklimatickými podmienkami

Agricultural and Forest Meteorology 291 (2020) 108066

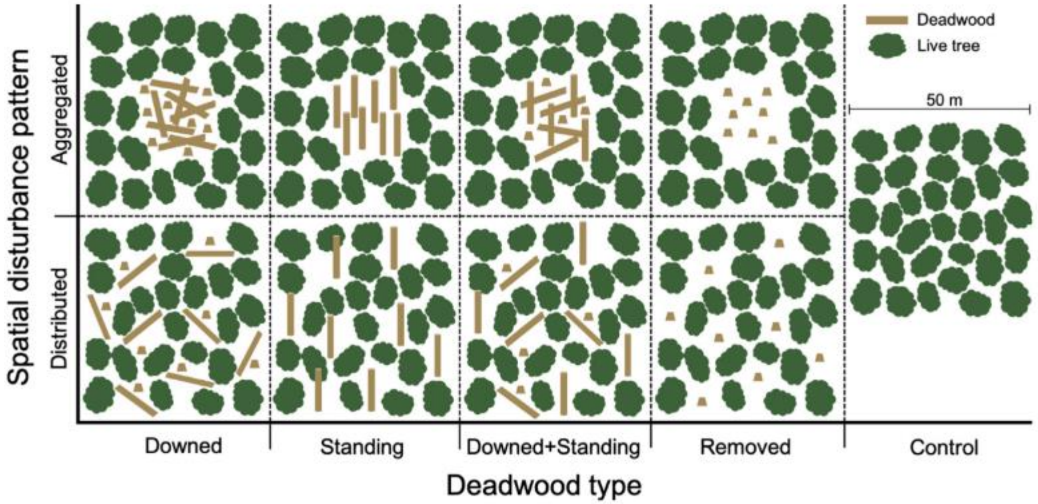
Contents lists available at ScienceDirect

Agricultural and Forest Meteorology

journal homepage: www.elsevier.com/locate/agrformet

Effects of disturbance patterns and deadwood on the microclimate in European beech forests

Dominik Thom[a,b,c,*], Andreas Sommerfeld[b], Julius Sebald[a,b], Jonas Hagge[d], Jörg Müller[e,f], Rupert Seidl[a,b,g]



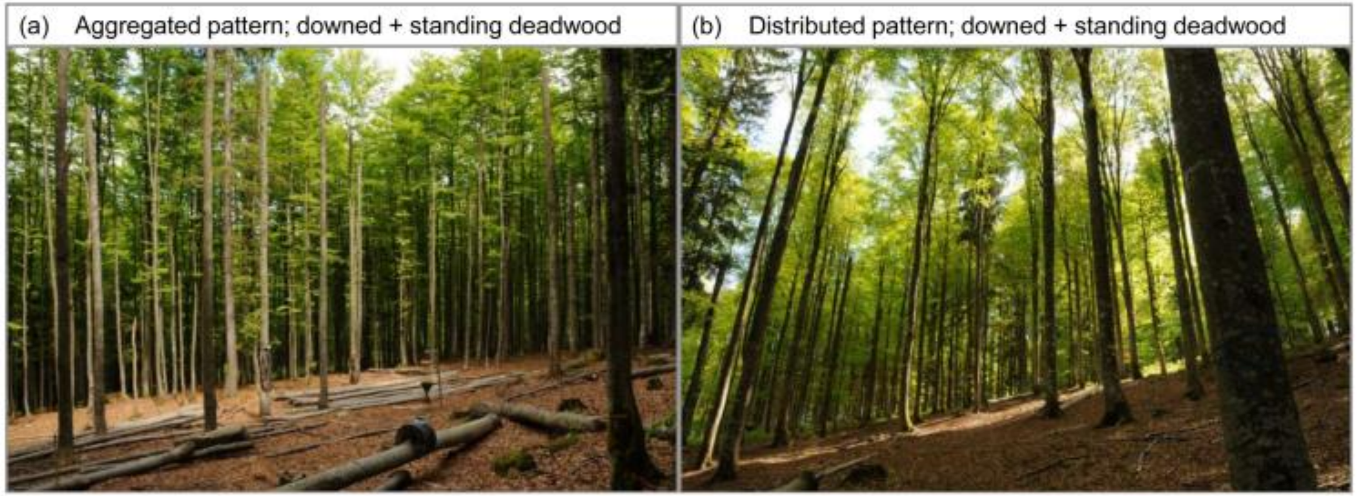


Figure 3. An example of the aggregated and distributed disturbance treatment with both downed and standing deadwood.

Les vekových tried - rúbaniská – vektor šírenia inváznych druhov

Úspešná regenerácia nepôvodných drevín (*Ailanthus altissima, Robinia pseudoacacia*) na rúbaniskách v dubových lesoch

Bylinné invázne druhy väčšinou dominujú dočasne

Rúbaniská – vektor šírenia inváznych druhov

Ťažba lesa predstavuje antropogénnu disturbanciu

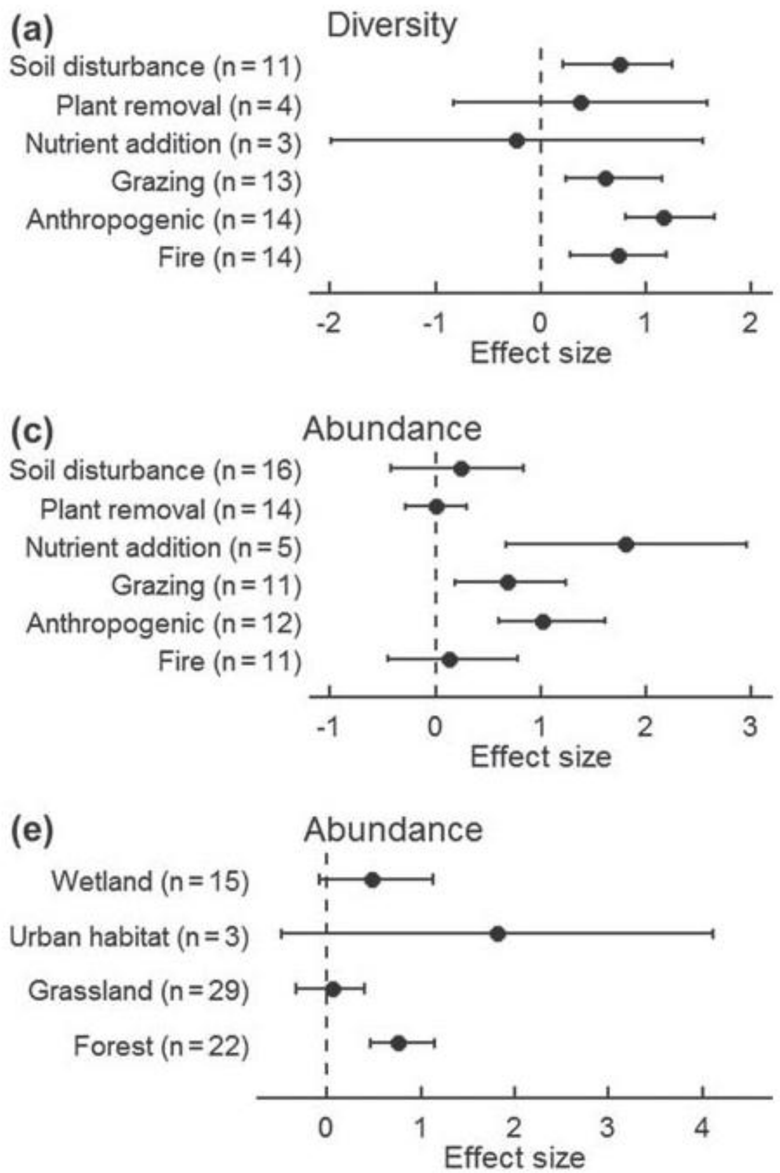
Disturbancie podporujú šírenie inváznych druhov

Oikos 124: 122–129, 2015
doi: 10.1111/oik.01416

Subject Editor: Christopher Lortie. Editor-in-Chief: Dries Bonte. Accepted 18 May 2014

Non-native plant species benefit from disturbance: a meta-analysis

Miia Jauni, Sofia Gripenberg and Satu Ramula



Forest Ecology and Management 569 (2024) 122225

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Control of invasive *Ailanthus altissima* in the Danube floodplain forests in Bratislava using chemical and biological agents

Michal Hrabovský [*,1], Marko Hladík

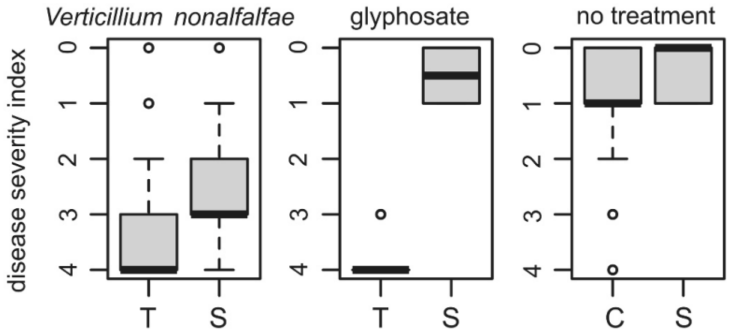


Fig. 3. Differences between treatments in the health of surrounding *Ailanthus altissima* individuals after three years; health is illustrated by a 0–4 scale, where 0 is a perfectly healthy individual and 4 is a dead individual; T – treated, inoculated trees, S – surrounding untreated trees that became infected via root grafts with inoculated trees, C – untreated control trees distant from inoculated trees.

Aplikácia chemikálií má rýchly a intenzívny účinok

Aplikácia biologického škodcu (huba) má dlhšie trvajúci nástup pôsobenia, mierne slabší, avšak poškodzuje aj stromy bez aplikácie

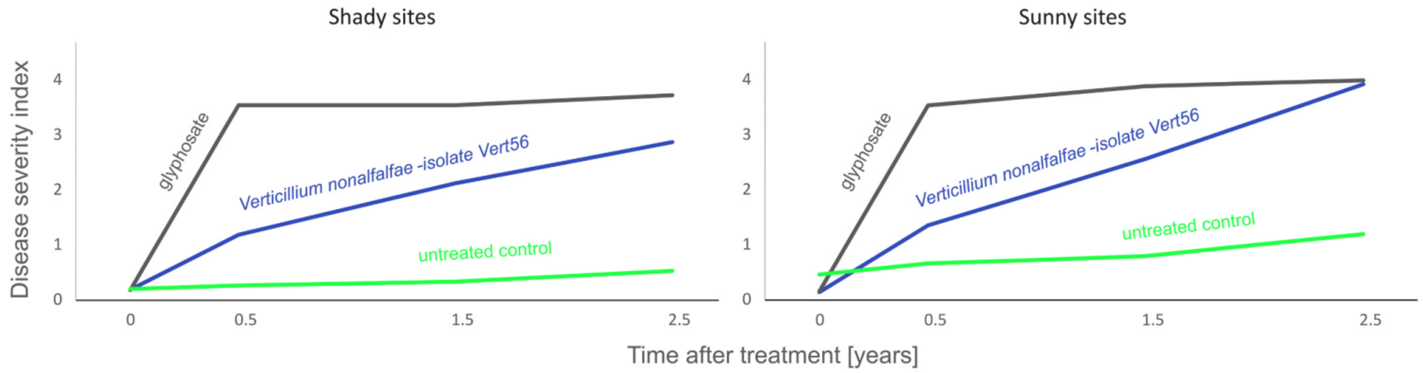


Fig. 2. Changes in health status of *Ailanthus altissima* within three years after inoculation with *Verticillium nonalfalfae* isolate Vert56 and glyphosate; health status is expressed by a 0–4 scale, where 0 is a perfectly healthy individual and 4 is a dead individual. An average disease severity index is used.

Stredný les

Príklad z Talianska – historický manažment (tretina každej generácie stromov ostáva)

Máliš F., Canullo R., Hédl R. 2015: Lesy centrálních Apenin – biodiverzita v kontextu historického a současného managementu, Živa, 63: 112-115

Apeniny

Vysoká rôznorodosť vo využívaní krajiny

Apeniny
Dreviny výmladkových lesov

Fagus sylvatica
Ostrya carpinifolia
Quercus spp.
Fraxinus ornus
a iné

Apeniny

Špecifická forma výrubu drevín počas ťažby

Účelom je pôdoochranná funkcia na strmých svahoch

Peň ostáva živý

Potenciál lesov pri zmierňovaní dopadov GEZ

Sekvestrácia uhlíka

rastliny (stromy) viažu CO_2 z atmosféry, žijú a rastú z neho (vznik biomasy)

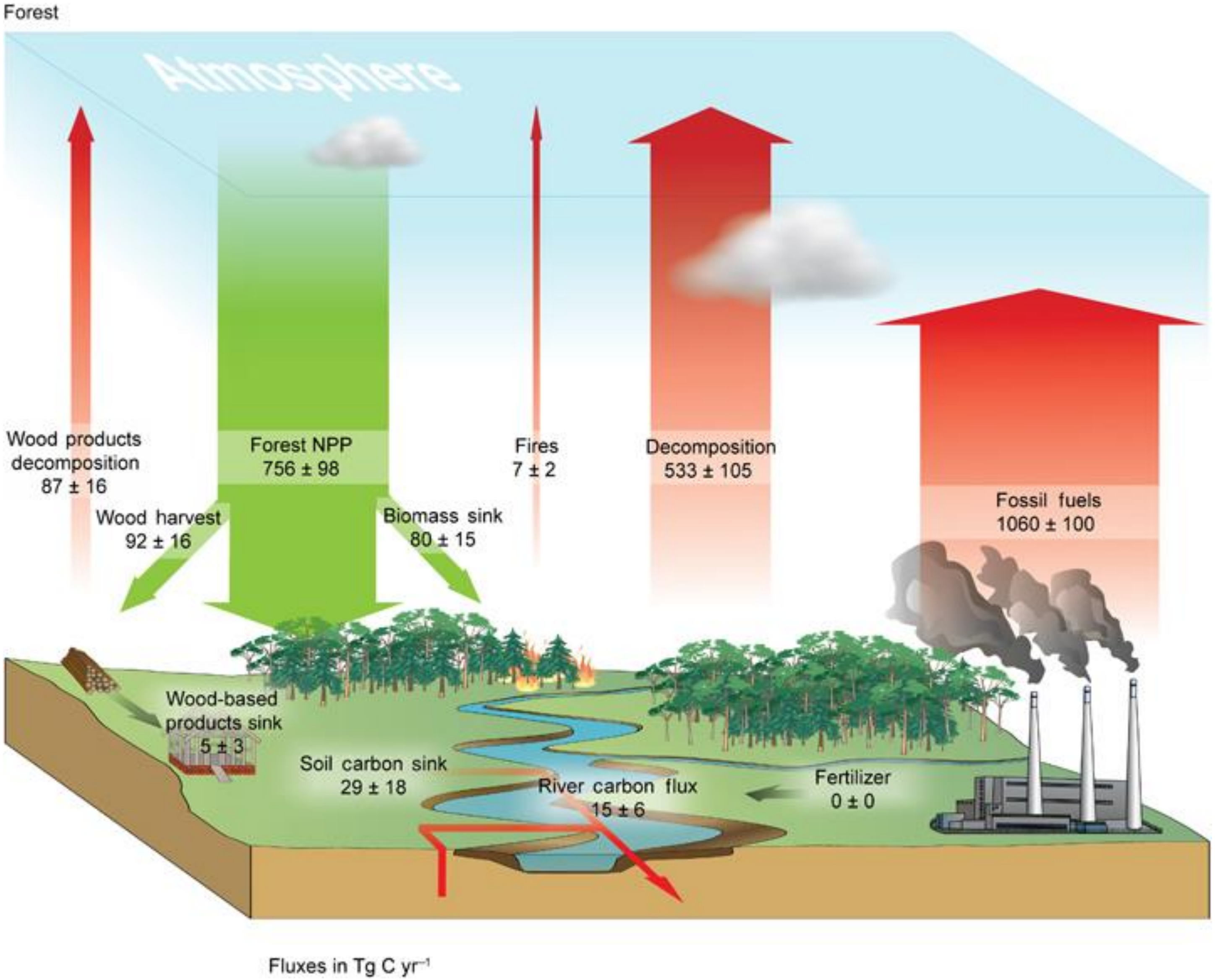
veľká časť (cca 70 %) biomasy sa rozloží a uvoľní

časť sa uloží v pôdach, o čosi viac vyťaží

vyťažené drevo využiť inak ako na palivo (fixácia na dlhšiu dobu)

horenie dreva (palivo alebo požiare) znova uhlík uvoľní do atmosféry (využitie na palivo je však vždy lepšie ako kúriť fosílnymi palivami)

fosílne palivá drevom nenahradíme – potreba znížiť ich spotrebu



Bilancia pre štáty EÚ

Luyssaert et al. (2010). The European carbon balance. Part 3: forests. Global Change Biology, 16(5), 1429-1450.

Sekvestrácia a akumulácia uhlíka v pôde

Obsah uhlíka v pôde je vyšší v prírodných lesoch ako v hospodárskych
Akumulácia uhlíka v prírodných lesoch narastá (nemajú stabilnú zásobu uhlíka)

BREVIA

Old-Growth Forests Can Accumulate Carbon in Soils

GUOYI ZHOU, SHUGUANG LIU, ZHIAN LI, DEQIANG ZHANG, XULI TANG, CHUANYAN ZHOU, JUNHUA YAN, AND JIANGMING MO Authors Info & Affiliations

SCIENCE • 1 Dec 2006 • Vol 314, Issue 5804 • p. 1417 • DOI: 10.1126/science.1130168

Abstract

Old-growth forests have traditionally been considered negligible as carbon sinks because carbon uptake has been thought to be balanced by respiration. We show that the top 20-centimeter soil layer in preserved old-growth forests in southern China accumulated atmospheric carbon at an unexpectedly high average rate of 0.61 megagrams of carbon hectare-1 year-1 from 1979 to 2003. This study suggests that the carbon cycle processes in the belowground system of these forests are changing in response to the changing environment. The result directly challenges

CURRENT ISSUE

Vol 455|11 September 2008|doi:10.1038/nature07276 nature

LETTERS

Old-growth forests as global carbon sinks

Sebastiaan Luyssaert[1,2], E. -Detlef Schulze[3], Annett Börner[3], Alexander Knohl[4], Dominik Hessenmöller[3], Beverly E. Law[2], Philippe Ciais[5] & John Grace[6]

Matters arising

Old-growth forest carbon sinks overestimated

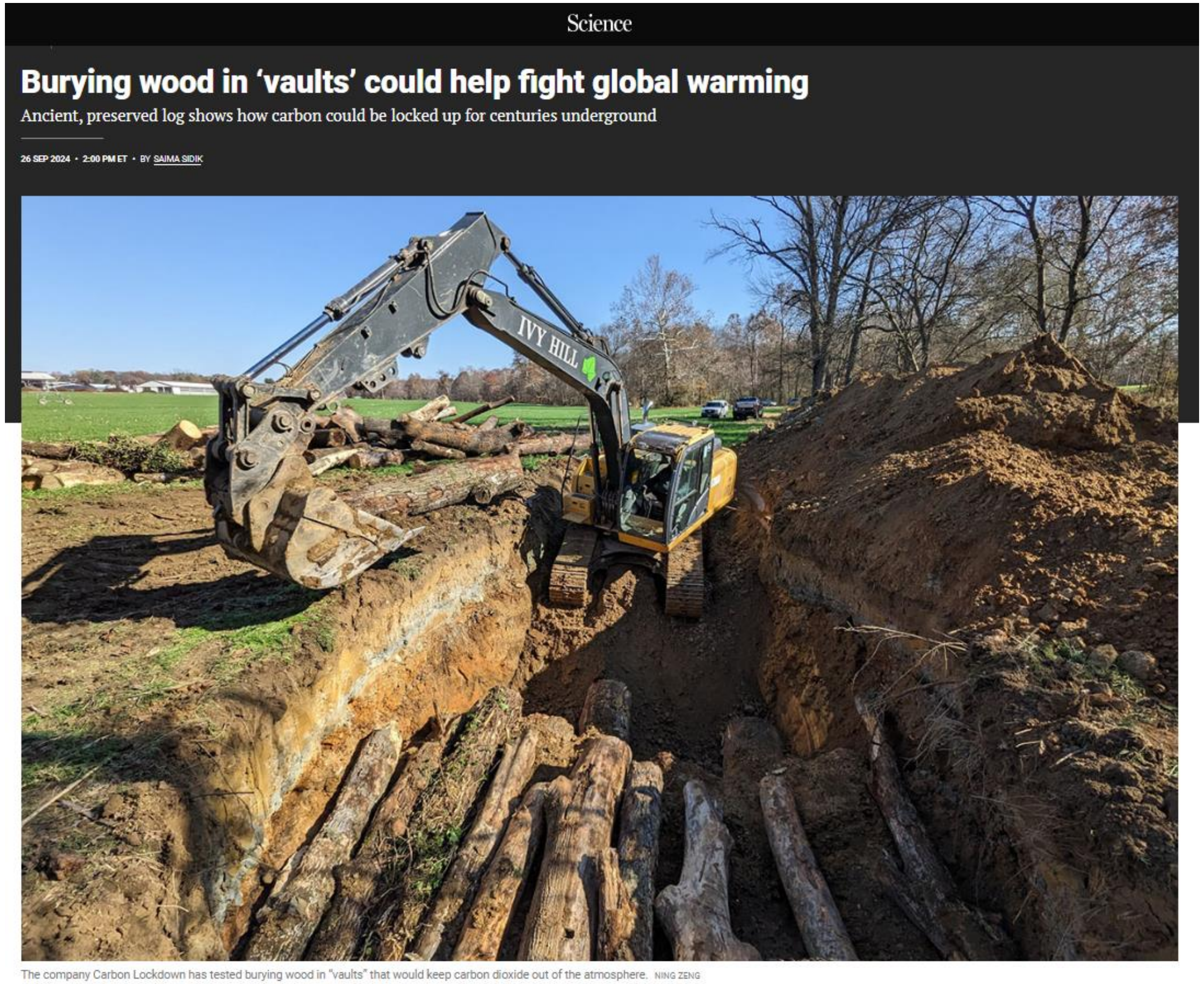
https://doi.org/10.1038/s41586-021-03266-z
Received: 10 March 2020
Accepted: 19 January 2021
Published online: 24 March 2021
Check for updates

Per Gundersen[1]✉, Emil E. Thybring[1], Thomas Nord-Larsen[1], Lars Vesterdal[1], Knute J. Nadelhoffer[2] & Vivian K. Johannsen[1]

ARISING FROM: S. Luyssaert et al. *Nature* https://doi.org/10.1038/nature07276 (2008)

Ukladanie uhlíka v pôde

Jednou z možností je „pochovávanie“ dreva, alebo „utopenie“ vo vode


Science

Burying wood in ‘vaults’ could help fight global warming

Ancient, preserved log shows how carbon could be locked up for centuries underground

26 SEP 2024 • 2:00 PM ET • BY SAIMA SIDIK

The company Carbon Lockdown has tested burying wood in “vaults” that would keep carbon dioxide out of the atmosphere. NING ZENG

A 3775-year-old log held onto 95% of its carbon because it was buried in a water-logged clay lacking in oxygen. NING ZENG

Ning Zeng a kolektív skúmali 3775 rokov staré drevo, ktoré si zachovalo 95% uhlíka, pretože bolo v podmáčanej ílovitej pôde bez prístupu kyslíka

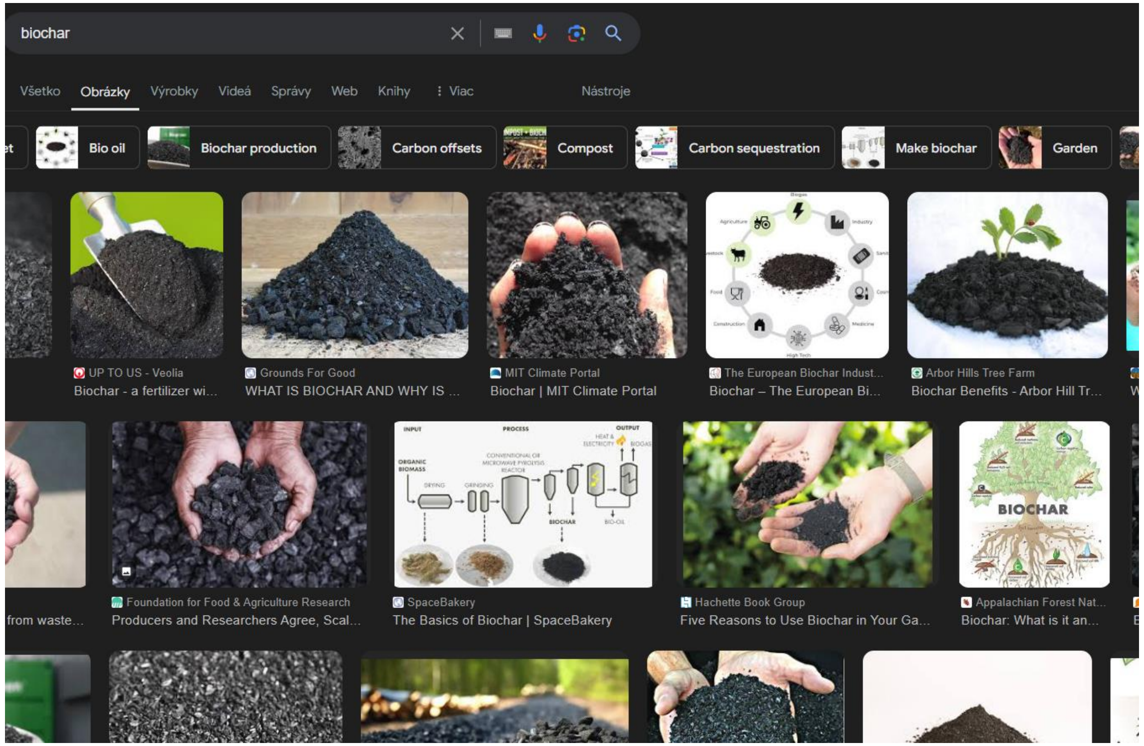
Zeng et al. 2024: Science 385, No. 6716, DOI: 10.1126/science.adm8133

Ukladanie uhlíka v pôde – Biochar (biouhlie)

Drevné uhlie vyrobené procesom pyrolýzy („zohriatie“ dreva bez prístupu kyslíka)

Uhlík je v biouhlí fixovaný, v pôde sa nerozkladá

Zapracovanie do pôdy mení vlastnosti pôd a môže byť prospešné pre rastliny




Forest Ecology and Management 474 (2020) 118362

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

ELSEVIER

Biochar amendment increases tree growth in nutrient-poor, young Scots pine stands in Finland

Marjo Palviainen[a,*], Heidi Aaltonen[a], Ari Laurén[b], Kajar Köster[a], Frank Berninger[c], Anne Ojala[d], Jukka Pumpanen[e]

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Swedish forest growth decline: A consequence of climate warming?

Hjalmar Laudon [a,*], Alex Appiah Mensah [b], Jonas Fridman [b], Torgny Näsholm [a], Sandra Jämtgård [a]

Sekvestrácia uhlíka znížená kvôli poklesu rastu stromov ako dôsledok klimatickej zmeny

Efekt „hnojenia“ oxidom uhličitým, ale následne prejavy sucho

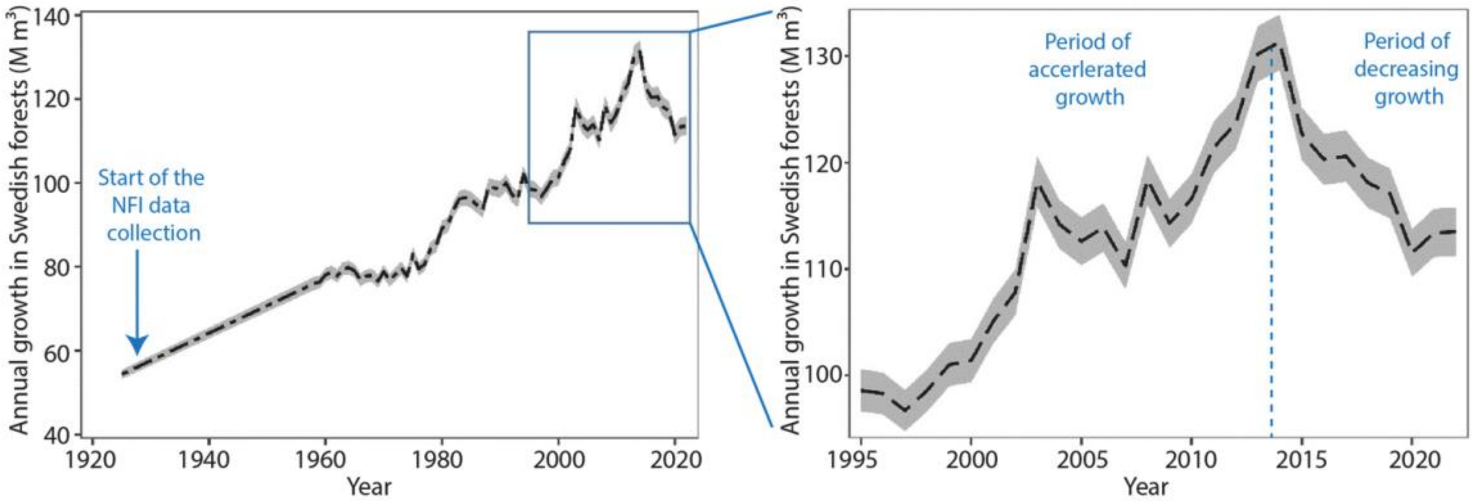


Fig. 1. Trends in annual incremental growth since the beginning of the Swedish National Forest Inventory (NFI) data collection in 1920 (left), as well as an enlarged view from 1995 to the present (right). Each annual data estimate is based on over 100,000 annually inventoried sample trees, which are aggregated into 5-year running averages. Data between 1925 and 1958 are linearly interpolated, thereafter running five-year averages. The grey area denotes the uncertainty band of the annual growth estimates.

Sekvestrácia uhlíka je značne narušená disturbanciami

Trvá 30 – 40 rokov kým sa obnoví zásoba uhlíka v lesnom ekosystéme

Contents lists available at ScienceDirect

Agricultural and Forest Meteorology

journal homepage: www.elsevier.com/locate/agrformet

Post-disturbance recovery of forest carbon in a temperate forest landscape under climate change

Laura Dobor[a], Tomáš Hlásny[a,*], Werner Rammer[b], Ivan Barka[c], Jiří Trombik[a], Pavol Pavlenda[c], Vladimír Šebeň[c], Petr Štěpánek[d], Rupert Seidl[b]

[a] Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, Kamýcká 129, 165 21 Prague 6, Czech Republic
[b] University of Natural Resources and Life Sciences (BOKU) Vienna, Peter Jordan Straße 82, 1190 Wien, Austria
[c] National Forest Centre – Forest Research Institute Zvolen, T. G. Masaryka 22, 960 92 Zvolen, Slovak Republic
[d] Global Change Research Institute CAS, Bělidla 986/4a, Brno 603 00, Czech Republic

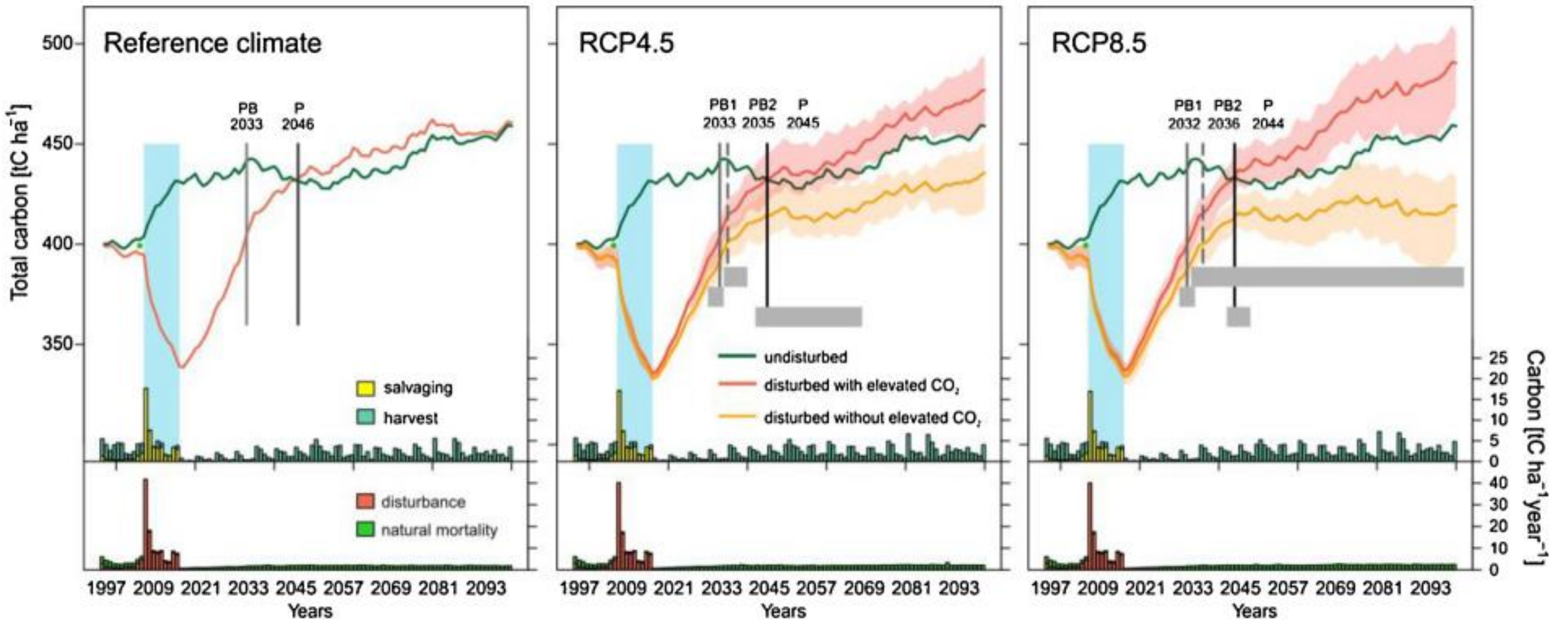


Fig. 3. Simulated total ecosystem carbon (C_{total}) and its post-disturbance recovery. The disturbed forest development is simulated under three different climate conditions, as well as with and without the fertilizing effect of CO_2. The reference undisturbed development was generated under reference climate corresponding to the period 1961-1990. Simulations under climate change are driven by seven climate models for each RCP scenario; solid lines indicate the average projection and shaded envelopes indicate the minimum–maximum range of the simulations. Grey rectangles indicate the inter-model range of payback time (PB1 with elevated CO_2; PB2 without elevated CO_2) and the C parity (P). Columns at the bottom indicate the annual C amount removed from the landscape by harvests and salvage cutting, and the annual C in dead trees. In case of RCP scenarios, columns show multi-model means under elevated CO_2 level. The blue vertical rectangle indicates the wind-bark beetle disturbance episode investigated here (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

Forest Ecology and Management 559 (2024) 121816

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Are uneven-aged forests in Central Europe less affected by natural disturbances than even-aged forests?

Johannes Mohr[a,*], Dominik Thom[a,b], Hubert Hasenauer[c], Rupert Seidl[a,d]

Rôznoveké porasty sú menej postihované disturbanciami ako rovnoveké

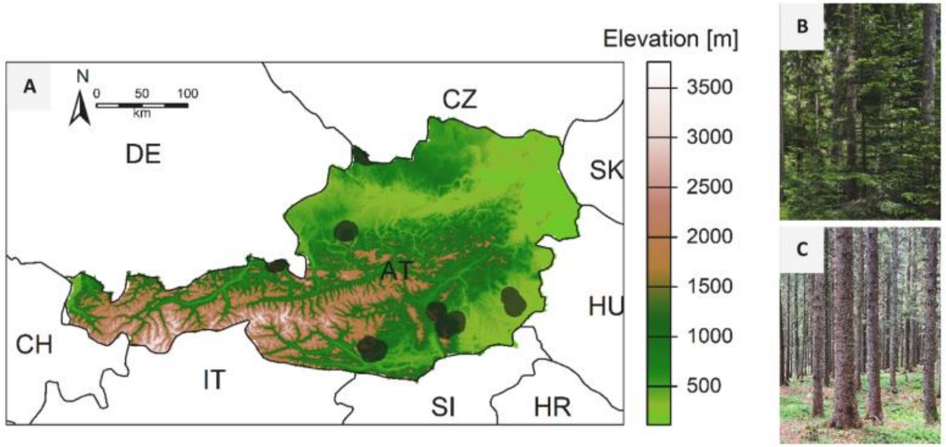


Fig. 1. : **A**: Study sites under uneven-aged management and their approximate location in Austria. Examples for typical forest structures under **B**: uneven-aged management, and **C**: even-aged management in the study region.

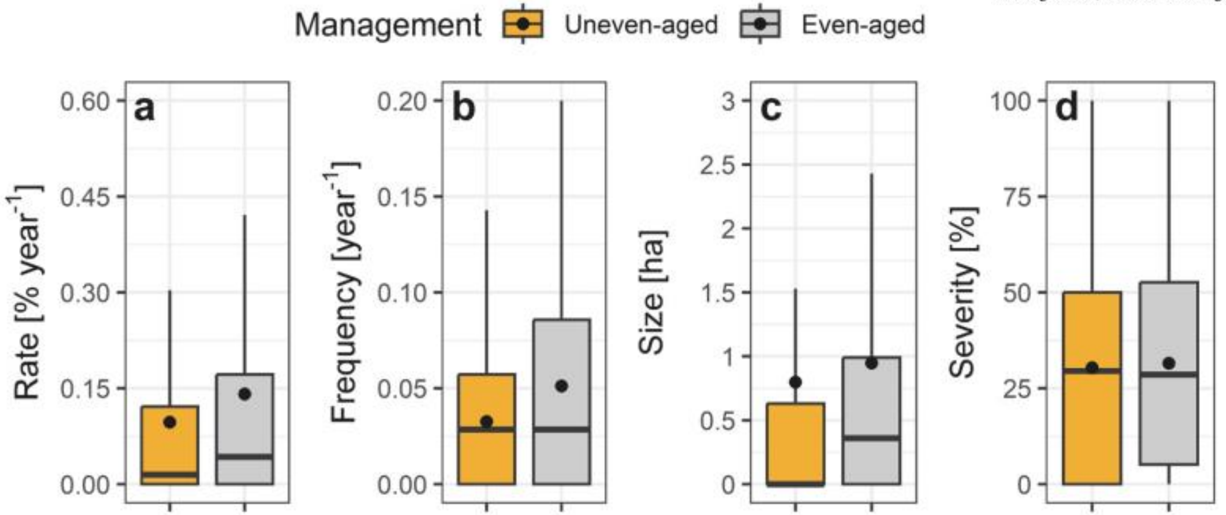


Fig. 3. Uneven-aged forests are less affected by natural disturbances than even-aged forests. Differences in the disturbance regimes of uneven-aged and even-aged forests: **a)** disturbance rate, **b)** disturbance frequency, **c)** maximum patch size, and **d)** the proportion of high severity disturbances. Mean values are depicted as points, medians as horizontal lines, and interquartile ranges (IQR) as boxes, while whiskers illustrate data points within the range of Q1 – 1.5IQR to Q3 + 1.5IQR, with Q1 and Q3 representing the first and third quartiles, respectively.

Adaptácia spôsobov obhospodarovania lesov

95 % lesov je obhospodarovaných – využitie potenciálu pre zmiernenie dopadov GEZ je v rukách obhospodarovateľov

lesníci nemôžu ovplyvniť globálne javy, ale môžu prispôsobiť obhospodarovanie v prospech zmiernenia ich dopadov

množstvo pozitívnych príkladov, ale aj nesprávnych prístupov

Pár základných foriem, termínov

Prírode blízke formy obhospodarovania lesa budú témou samostatnej prednášky
Teraz pár medzinárodných termínov

Regenerative forestry

Snaha akumulovať (zachytávať) v lesnom ekosystéme čo najviac uhlíka

V súčasnosti je v praxi realizované hlavne regenerative agriculture

Potreba rozvoja konceptu pre lesníctvo na základe kvantifikácie množstva zachyteného uhlíka

Pár základných foriem, termínov

Continuous cover forestry

Výberkový les

Nepretržitá kontinuita zápoja

Maloplošnosť ťažby na úrovni jednotlivých stromov

Pár základných foriem, termínov

Selective logging

V priestore heterogénna ťažba

Ťažba od jednotlivých stromov
po skupiny (porastové medzery)

Časové rámce – postupné
zväčšovanie...

https://eos.com/blog/selective-logging/

Pár základných foriem, termínov

Retention forestry

Ponechávanie rôznorodých porastových zvyškov

Rôzna veľkosť, hustota a čas ich ponechania

Individuálne stromy, skupiny stromov (riedke, husté)

Na krátku dobu, na dožitie (mŕtve drevo)

Figure 1. Photos illustrating retention forestry in different parts of the world. The common feature is a long-term and planned retention of biological legacies, including dispersed and aggregated trees, over forest generations with the aim of maintaining biodiversity and ecosystem functions. The levels and designs of this approach, which has been practiced for more than 20 years, differ considerably depending on ecological conditions, policy settings, and social contexts. (a) Group retention in coastal British Columbia, Canada. Photograph: William J. Beese. (b) Tree and habitat retention in a gap release treatment in Jarrah Forest, Western Australia. Photograph: Deirdre Maher. (c) Small aggregate and created dead wood in boreal Sweden. Photograph: Lena Gustafsson. (d) Dispersed retention in Washington State. Photograph: Cassandra Koerner.

Gustafsson et al. (2012). Retention forestry to maintain multifunctional forests: a world perspective. BioScience, 62(7), 633-645.

Pár základných foriem, termínov

Retention forestry

Ambio 2020, 49:85–97
https://doi.org/10.1007/s13280-019-01190-1

PERSPECTIVE

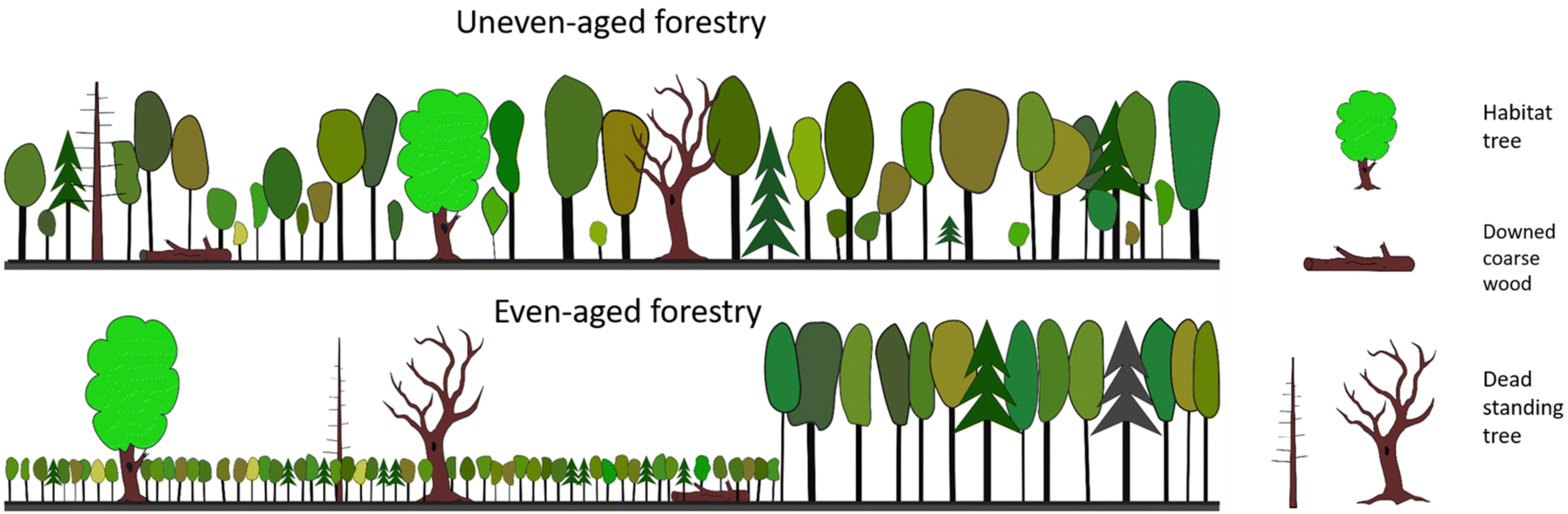
Retention as an integrated biodiversity conservation approach for continuous-cover forestry in Europe

Lena Gustafsson, Jürgen Bauhus, Thomas Asbeck, Andrey Lessa Derci Augustynczik, Marco Basile, Julian Frey, Fabian Gutzat, Marc Hanewinkel, Jan Helbach, Marlotte Jonker, Anna Knuff, Christian Messier, Johannes Penner, Patrick Pyttel, Albert Reif, Felix Storch, Nathalie Winiger, Georg Winkel, Rasoul Yousefpour, Ilse Storch

Ponechávanie rôznorodých porastových zvyškov

Ponechané individuálne stromy – tzv. biotopový strom (*habitat tree*), mikrobiotopy pre rôzne organizmy

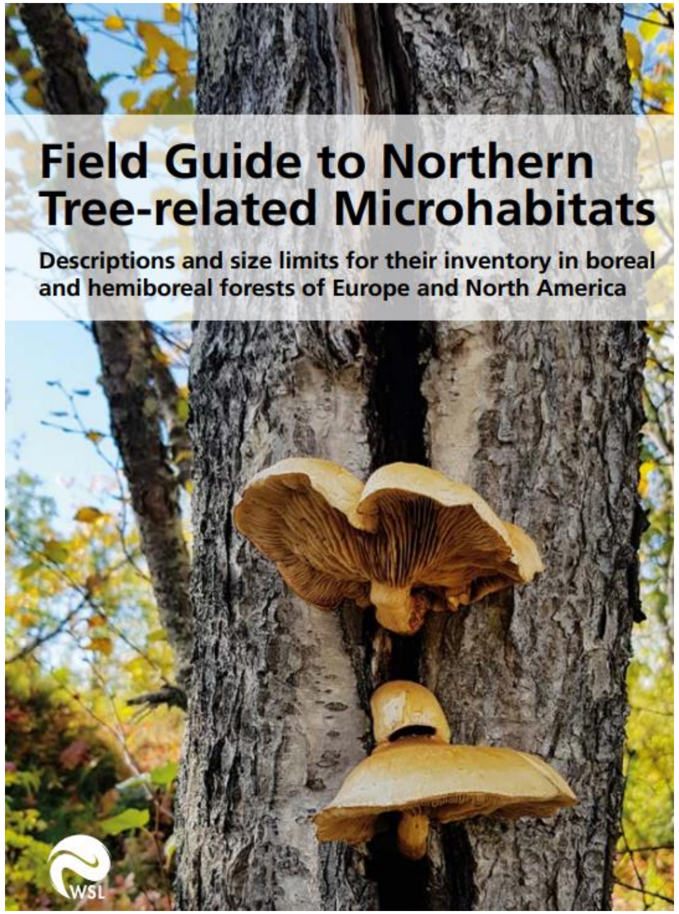
Mŕtve drevo – stojace, ležiace



Pár základných foriem, termínov

Biotopový strom – prvok retention forestry

Habitat tree – strom s rôznymi prvkami vhodnými ako mikrobiotop pre rôzne organizmy



Suggested reference for bibliography:
Bütler, R., Larrieu, L., Lunde, L.F., Martin, M., Nordén, B., Reiso, S., Tremblay, J.A., Wetherbee, R. 2024. Field Guide to Northern Tree-related Microhabitats: Descriptions and size limits for their inventory in boreal and hemiboreal forests of Europe and North America. Birmensdorf, Swiss Federal Institute for Forest, Snow and Landscape Research WSL. 68 p.

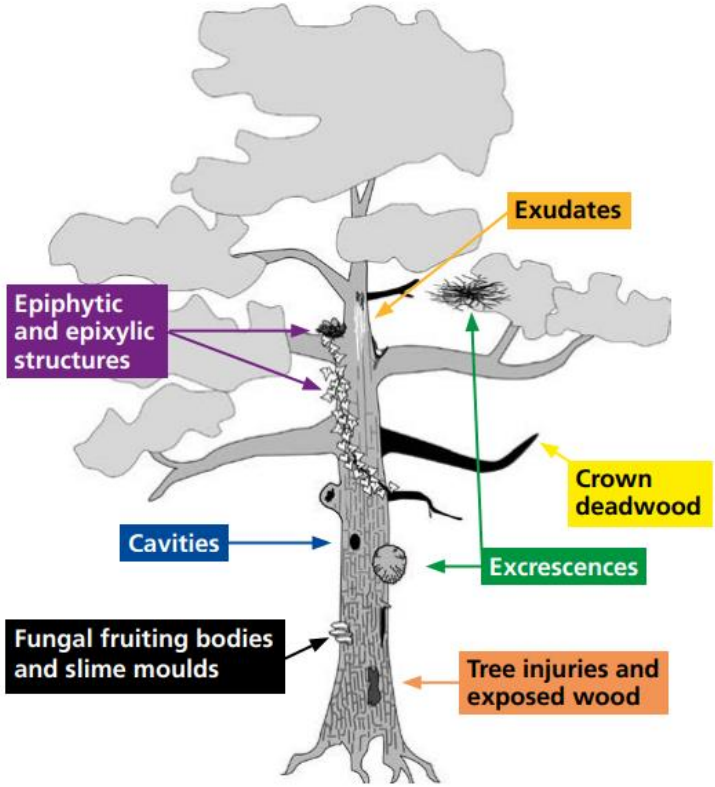
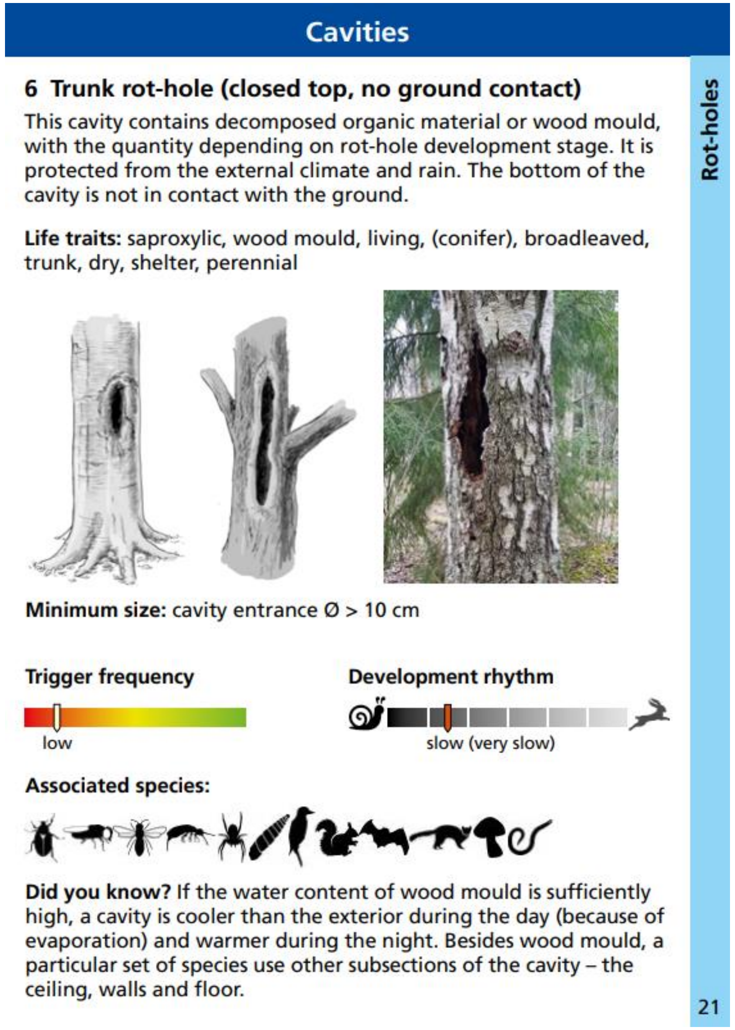


Fig. 1. A habitat tree bearing tree-related microhabitats essential to specialised species for shelter, breeding spots, hibernating or feeding, or even for their entire life cycle.



Cavities

6 Trunk rot-hole (closed top, no ground contact)

This cavity contains decomposed organic material or wood mould, with the quantity depending on rot-hole development stage. It is protected from the external climate and rain. The bottom of the cavity is not in contact with the ground.

Life traits: saproxylic, wood mould, living, (conifer), broadleaved, trunk, dry, shelter, perennial

Minimum size: cavity entrance Ø > 10 cm

Trigger frequency low

Development rhythm slow (very slow)

Associated species:

Did you know? If the water content of wood mould is sufficiently high, a cavity is cooler than the exterior during the day (because of evaporation) and warmer during the night. Besides wood mould, a particular set of species use other subsections of the cavity – the ceiling, walls and floor.

Rot-holes

21

Špecifický manažment podľa disturbančného režimu

Manažment simulujúci prírodné procesy


frontiers in Forests and Global Change

HYPOTHESIS AND THEORY
published: 09 April 2021
doi: 10.3389/ffgc.2021.629020

Check for updates

Natural Disturbance-Based Forest Management: Moving Beyond Retention and Continuous-Cover Forestry

Timo Kuuluvainen[1], Per Angelstam[2], Lee Frelich[3], Kalev Jõgiste[4], Matti Koivula[5], Yasuhiro Kubota[6], Benoit Lafleur[7] and Ellen Macdonald[8]*

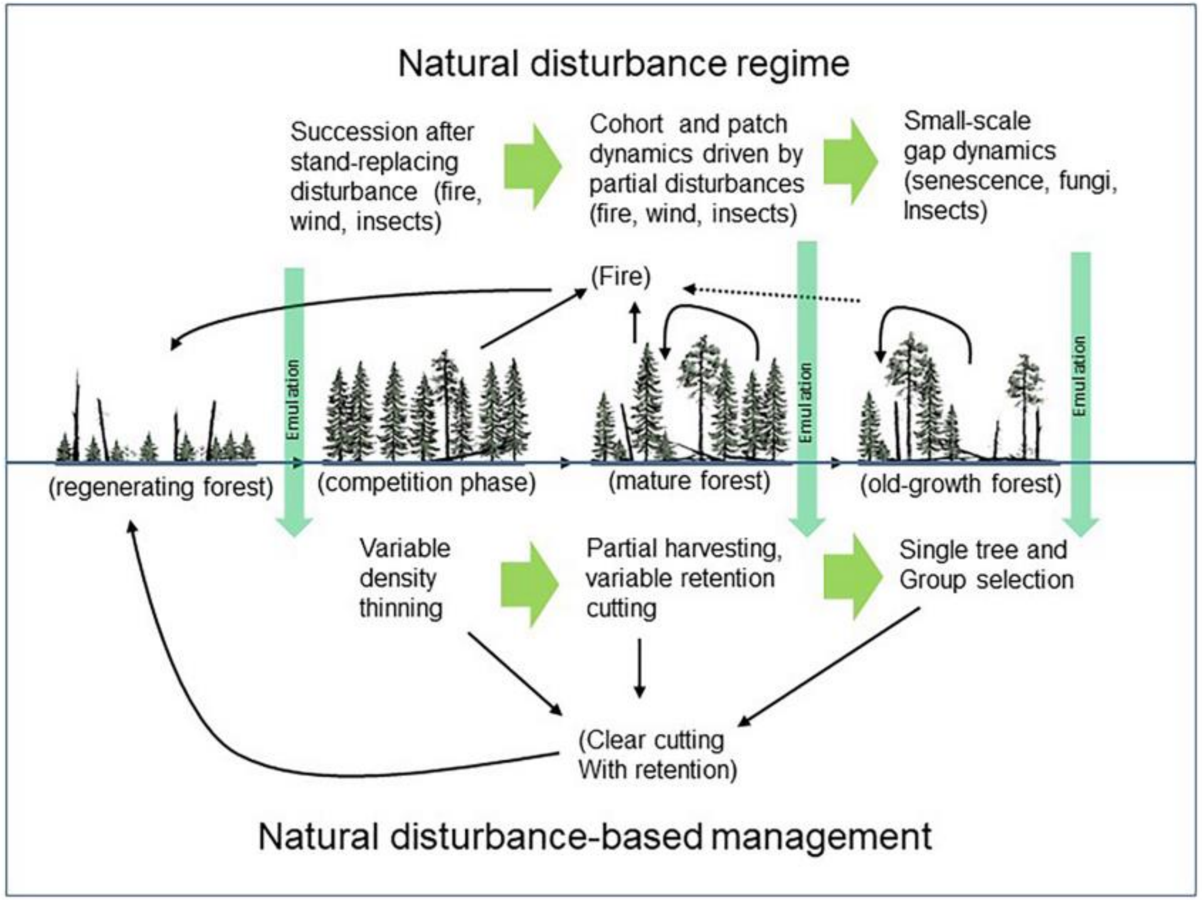


FIGURE 3 | Illustration on how knowledge about natural disturbance regimes can be used in natural disturbance-based management (Bergeron et al., 2002). Here the forest successional sequence is divided into four developmental phases after stand-replacing disturbance, with their typical internal dynamics: regeneration, competition, mature and old-growth. Silvicultural tools are used in each phase to emulate natural disturbances. Retention of ecological legacies (living and dead trees) is applied in regeneration cutting, variable-density thinning is used to emulate competition-phase dynamics, partial harvesting and high-retention cutting can be used to imitate opening up of canopy, and structure and dynamics of old forests are emulated by selective and group harvesting. The desired proportions of developmental phases are derived from a reference landscape (if available) or from the historical reference-disturbance regime (Drawing by J. Karsisto, modified from Kuuluvainen et al., 2017).

Špecifický manažment podľa disturbančného režimu

Priestorovo heterogénena forma ťažby s ponechávaním rôznorodých porastových zvyškov
A – napodobenie požiaru
B – veľké a malé porastové zvyšky + okrajová ochrana rašeliniska
C – stredne veľké porastové zvyšky organizované v priestore na podporu konektivity (biokoridory)
D – druhovo rôznorodý porastový zvyšok

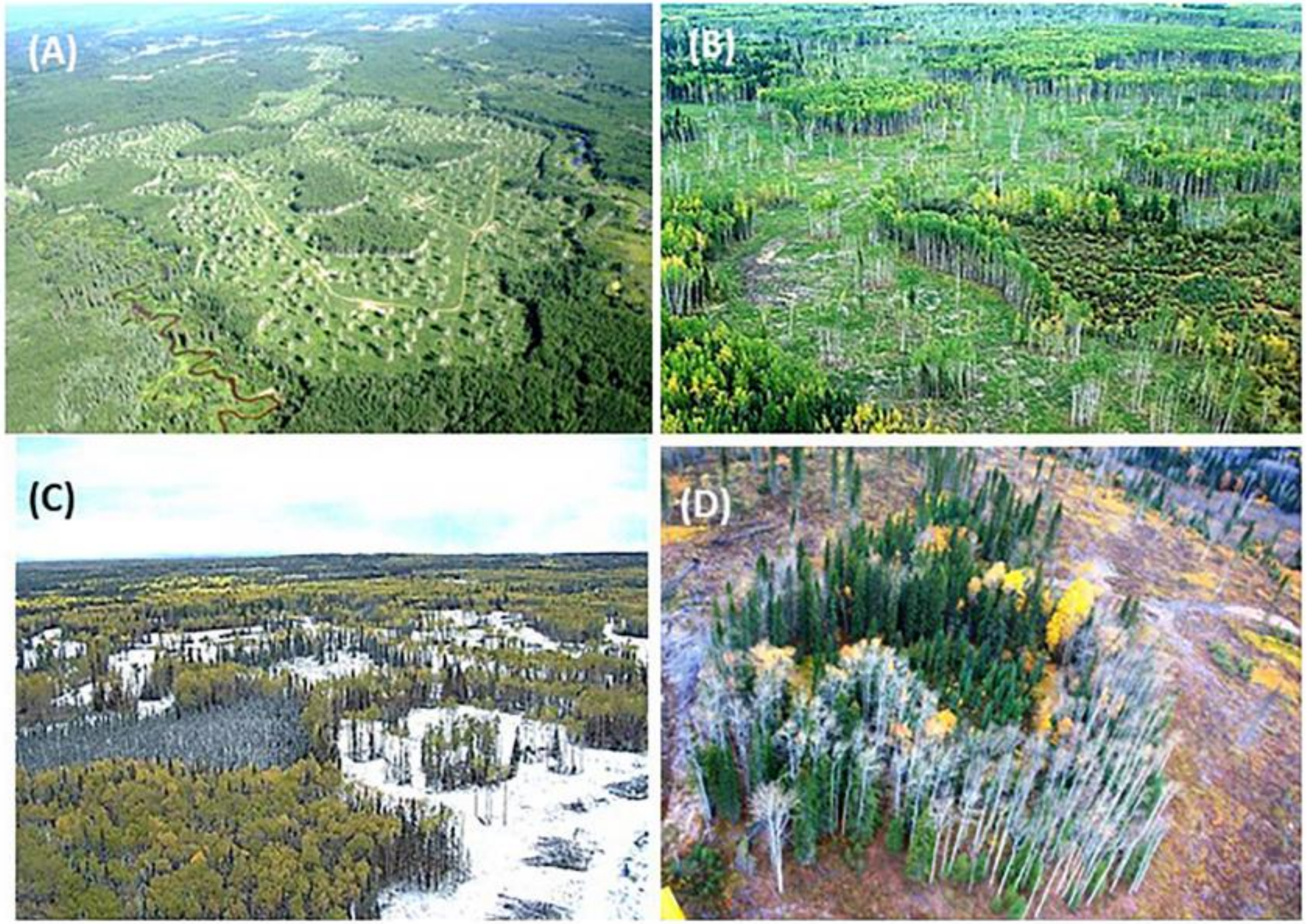


FIGURE 4 | Approaches to natural disturbance-based management in the western Canadian boreal forest. **(A)** Cutover area including a mixture of small and large patch retention; shape of the cut area and pattern of retention are designed to mimic residuals left by wildfire. **(B)** Retention left as a mixture of small patches, large patches, and a buffer next to a peatland. **(C)** Retention left as a mixture of medium-size patches and small patches arranged to improve landscape connectivity. **(D)** Retention patch specifically designed to include a mixture of conifer and hardwoods.

Biodiversity and Conservation
https://doi.org/10.1007/s10531-024-02878-x

REVIEW PAPER

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Achieving structural heterogeneity and high multi-taxon biodiversity in managed forest ecosystems: a European review

Britta Uhl[1] · Peter Schall[2] · Claus Bässler[3,4,5]

Rôzne práce syntetizujúce formy obhospodarovania v kontexte štruktúry, biodivezity a vhodnosti z pohľadu GEZ

Table 1 Overview over different forest structure types, their predicted effect on α- and beta-diversity, and the according management systems, with which such forest structures are promoted

Forest structure	Vegetation layers = local heterogeneity	Landscape scale heterogeneity	Management systems	Details	Creates good habitat quality for...	Suitable for ...
	Even-aged (single-layered) (↓ α-diversity)	High (↑ β-diversity)	• Clearcutting • Plantation (short rotation, coppice) • Regular shelterwood	• Trees have same age • Trees harvested at once (large clearcuts) • Low tree diversity	• Pioneer species • Plant communities • Young forest specialists	• Boreal forest • Hemiboreal and nemoral coniferous/mixed forest • Mire and swamp forest • Non-riverine alder/birch/aspen forest
	Uneven-aged (two-layered) (↘ α-diversity)	high (↑ β-diversity)	• Regular shelterwood (only initial thinning) • Extended irregular shelterwood	• Canopy is opend by removing many trees • After two cutting events, only young trees remain	• Open forest species • Birds and insects • Plant communities • To some extend: Pioneer species	• Boreal forest • Hemiboreal and nemoral coniferous/mixed forest • Acidophilous oak(-birch) forest • Mesophytic deciduous forest • Mire and swamp forest
	Uneven-aged (multi-layered irregular) (↑ α-diversity)	high (↗ β-diversity)	• Expanding gap irregular shelterwood • Continuous cover irregular shelterwood	• A group of trees is removed resulting in small forest gaps • Small trees grow sheltered	• Forest edge species (many insects) • Bats (important preying areas)	• Boreal forest • Hemiboreal and nemoral coniferous/mixed forest • Mesophytic deciduous forest • Beech forest • Mire and swamp forest • Floodplain forest
	Uneven-aged (multi-layered balanced) (↗ α-diversity)	low (↓ β-diversity)	• Selection cutting	• Only selected trees are removed • Homogeneous closed-canopy, stable microclimate	• Closed-canopy species (many fungal species, if there is enough deadwood)	• Beech forest • Mountainous beech forest • Alpine forest
	Open forests (multi-layered) (↑ α-diversity)	medium (↘ β-diversity)	• Coppice with standards • Wood pasture	• Open canopy structure • Single standing trees with dense understory • Traditional management form	• Open forest species • birds and insects • Sunny deadwood users (many beetles)	• Hemiboreal and nemoral coniferous/mixed forest • Coniferous forests (Mediterranean ...) • Acidophilous oak(-birch) forest • Mesophytic deciduous forest • Thermophilous deciduous forest • Broadleaved evergreen forest
	Plenter-terminal forests (multi-layered) (↑ α-diversity)	medium (↘ β-diversity)	• Unmanaged forest reserves	• Very old trees • High amount of deadwood	• High diversity of various taxa • High conservation value	• Alpine forest • Mire and swamp forest • Floodplain forest

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REVIEW PAPER

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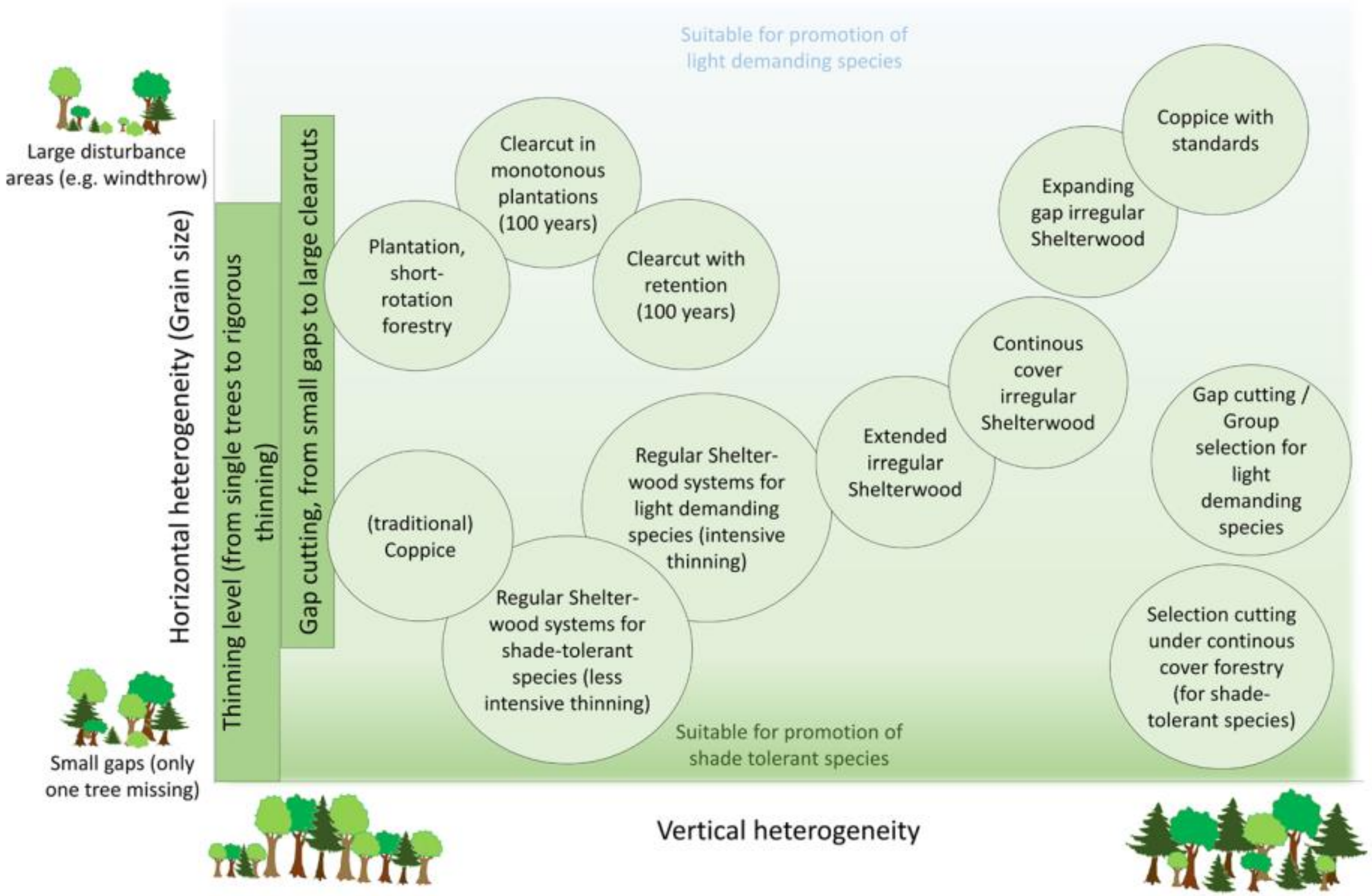


Fig. 3 Schematic overview showing how horizontal and vertical forest heterogeneity can be influenced by different forest management systems. Horizontal heterogeneity, which also refers to the "grain size" of disturbance/cutting areas, is defined by the thinning level, which in turn determines which tree species (shade tolerant vs. light demanding species) are to be promoted. Vertical heterogeneity describes the local structural configuration of a forest, which is strongly dependent on how forests are managed

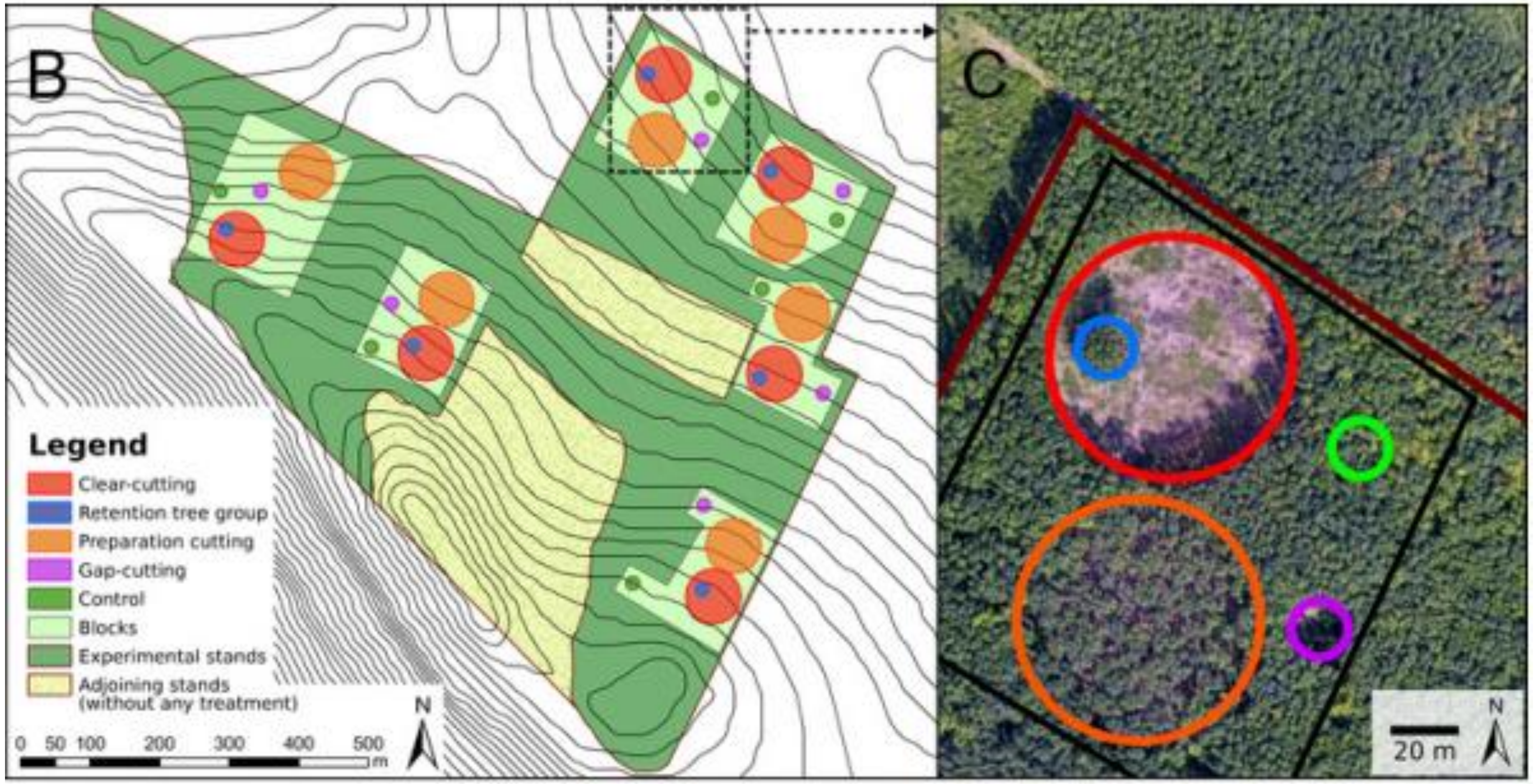
Nabudúce

Alternatívne formy obhospodarovania lesov (experimenty)

Klimaticky priaznivý manažment

Agrolesníctvo

Certifikácia



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